Cement MILL EDITION of
Concrete

Devoted to the Manufacture,
and Use, of Portland Cement

SEPTEMBER, 1934

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CONSTRUCTION GROUPS MUST PUSH MODERNIZATION

◆

THERE is nothing automatic about the operation of the modernization phases of the National Housing Act, discussed in an article in this issue of "Concrete."

¶ The Government has done its part by creating channels through which the necessary funds for modernization can be obtained. The administration of the Act has been intrusted to business men having years of experience back of them.

¶ But the success of the modernization campaign will depend, in each locality, upon the intelligence with which it is handled by local construction groups.

¶ Organized effort will be needed. Questions must be answered and the scope of the law must be explained. Owners of business buildings, apartment buildings, factories, warehouses, and so on, must be told that the law applies to such buildings no less than to small homes.

¶ And finally, individual architects, engineers, concrete products manufacturers and contractors can be of definite aid, and help themselves at the same time, through personal interviews with owners of residential and business buildings.

¶ Both through combined effort and through individual initiative the construction industry possesses the power to make this campaign worth while.

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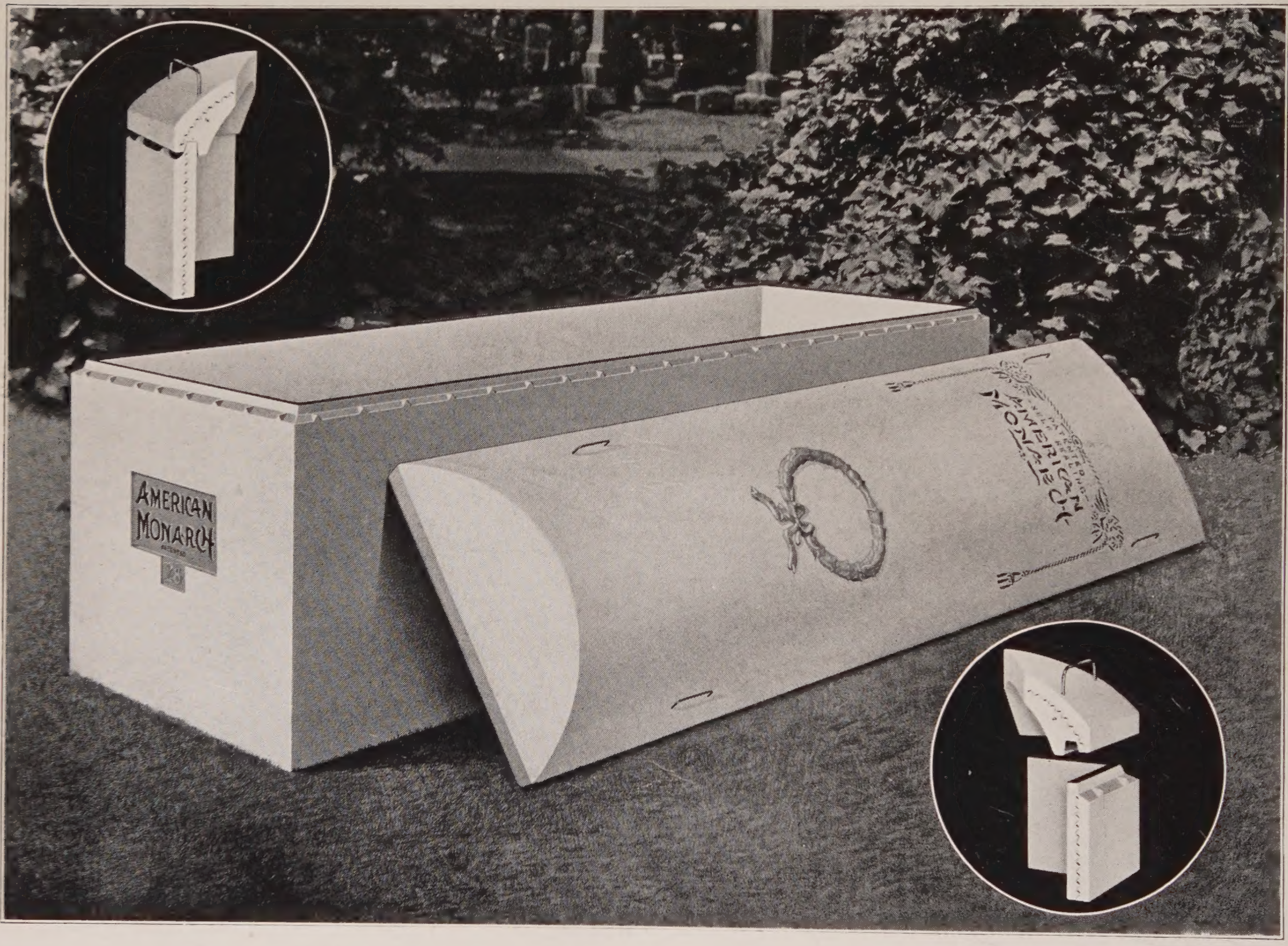

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Vol. XLII, No. 9 Concrete September, 1934

Build Cement-Bound Macadam Runway in C. & O. Railway Shops

Coarse Aggregate Is Stone Ballast—Penetration of Grout Is Complete—Construction Procedure Based on Elmhurst Test Road Practice

THE adaptability of cement-bound macadam for railway construction work, such as driveways and runways, station platforms, tool house and engine house floors, and track support slabs, is well demonstrated in a recently completed runway of this material, built by the Chesapeake & Ohio Railway at its shops in Huntington, W. Va.

Runway in Constant Use

Replacing an old timber plank runway, the new cement-bound macadam runway at Huntington is 370 ft. long, 10 ft. wide, and 8½ in. thick on the average. It is in constant use by tractors and trailers hauling miscellaneous stores materials. Wheel loads run as high as 2,000 lb., but average considerably less.

Many of the trailer units have steel tires. In consequence, the materials selected and the construction procedure followed were intended to insure a tough and smooth surface. The work was done by railway company forces.

Stone Ballast and Engine Sand as Aggregates

Coarse aggregate selected for the work was ordinary crushed stone ballast, graded from 1 to 2½ in., but containing some screenings and dirt. The screenings and dirt were removed by shaking the stone with stone forks as the aggregate was spread into place. Fine aggregate consisted of engine sand, somewhat finer than should have been used, since much of it passed the No. 28 sieve. The smoothness of this sand, furthermore, necessitated the use of more than the usual quantity of water—more than would have been required with a sharper sand. With the sand employed, the quantity of water used varied from 10 to 11 gallons to the sack of cement, compared with perhaps 8 gallons that might have been required with a coarser and sharper sand, and with a coarse aggregate having less range in particle size.

Procedure Based on Test Road

The construction procedure and the selection of proportions for the materials at hand were based in a large measure on the information developed by the Portland Cement Association in the construction of the experimental cement-bound macadam road at Elmhurst, Illinois, in 1933. The results of that very practical test were given careful study by Association engineers, whose findings have been published by the Association in a bulletin entitled "The Elmhurst Test Road—and What It Taught Us About Cement-Bound Macadam." This bulletin was mentioned in a news item on page 18 of the August (1934) issue of Concrete. Single copies may be obtained on request. The Elmhurst experimental road itself was described in an illustrated article on page 9 of the July (1933) issue of Concrete.

In the construction of the C. & O. runway a cinder base was placed, and thoroughly rolled with a roller weighing 900 lb. per lin. ft. of contact. Both the ground and the cinder fill were thoroughly wetted and compacted.

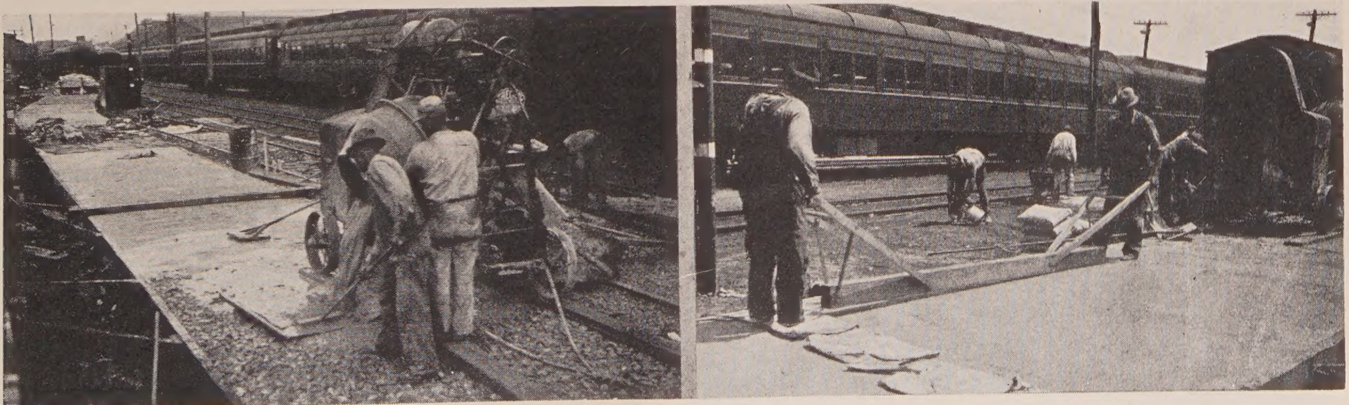


Figure 1 (Left). Grout being deposited direct from mixer. A metal plate prevented the force of the falling grout from dislodging stone particles. Figure 2 (Right). This tamper had a noticeable effect in compacting the cement-bound macadam and bringing excess water to the surface

Slab Is Reinforced

The crushed stone was first placed to a uniform depth of 3 in. Steel reinforcement was then laid, this reinforcement consisting of 5 longitudinal lines of rods, tied to transverse rods at 2-ft. intervals. The upper layer of crushed stone was then placed, struck off to a 1-in. crown, and compacted with a heavy plank template. Except where a boxed-in steam line was crossed, no transverse expansion joints were provided, although an over-night wooden bulkhead was placed at the end of each day's work.

Grouting Procedure

After the stone was spread and compacted, as just described, the grout was placed and spread. The grout mixture was proportioned on the basis of one sack of cement and 188 lb. of engine sand (about 1-1.7 by volume, considering the sand as dry and rodded). The fluidity was controlled with great care, for the reason that this factor has a direct effect on the thoroughness of the penetration and on the time interval between grouting and final finishing. This time interval increases as the proportional quantity of water is increased.

Fluidity of the grout was measured by means of a "flow cone," a device which enables the engineer to establish a definite relation between the time of flow and the penetrating qualities of the grout when a given aggregate is used.

Obtain Penetration without Air Pockets

Grout was deposited direct from the mixer, as shown in Figure 1, or by wheelbarrows. The grout was always placed so as to flow forward from an area already grouted, to avoid entrapment of air. The fall of the grout from the mixer was broken by a shovel or a metal plate placed on the compacted stone, thereby preventing dislodgment of individual particles of stone. The grout was pushed ahead with stiff floor brooms until only the tips of the stone were visible.

Proof of complete penetration of grout was obtained by scooping out small holes ahead of the advancing grout. Invariably, mortar was seen to flow into the bottom of the hole when the advancing grout had reached the surface of the stone within one or two feet of the hole.

Standard Finishing Methods Employed

The finishing procedure, likewise, followed the recommended practice as developed in the construction of the Elmhurst experimental road. After brooming the grout and moving the mixer ahead, tamping was started soon thereafter. The tamper consisted of a 4 by 6-in. oak timber plank, 10 ft. long, with plow handles at each end. The tamping operation (shown in Figure 2) consisted in first setting the tamper along one edge parallel to the forms, raising it one foot and dropping it at the two ends simultaneously. Then the tamper was shifted sideways about 3 in. at a time, until the opposite edge of the slab was reached.

Immediately after the first tamping, the surface was floated with long-handled wood floats. This was repeated after 30 minutes. The final finish was obtained by dragging a wet burlap blanket over the surface.

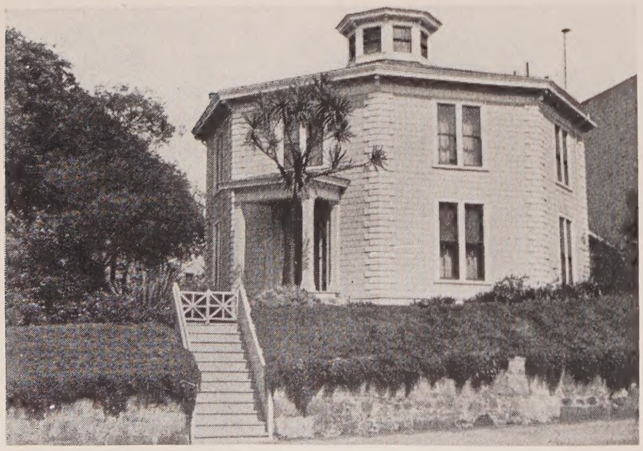
Excess Water Is Absorbed

As previously explained, the fineness and smoothness of the engine sand used necessitated the use of between 10 and 11 gallons of water to the sack of cement, in order to obtain perfect penetration. Fortunately, the cinder base absorbed much of this excess water, and the heat of the sun evaporated some of it, so that a good surface finish and a reasonably low water-cement ratio were obtained in 30 to 45 minutes after the grout was placed.

Following the burlap finishing operation, the surface of the newly-placed slab was wetted, and as soon as possible the slab was covered with old cloths, pieces of burlap and other materials. These were wetted down and kept wet for 3 days, so as to have the grout harden under the best possible conditions.

Monolithic Concrete House in San Francisco Built in 1864

By P. M. BRUNER
San Francisco, Calif.



Octagonal concrete house built in San Francisco in 1864

THIS interesting old San Francisco house was the first of five octagonal concrete houses built seventy years ago. It has been lived in continuously since it was built. An eastern man who moved to San Francisco during the gold rush days of 1849 thought he had solved the problem of providing all rooms with plenty of air and light and making all of them front rooms.

The walls are made of concrete. An examination of them has shown the mixture to be cement, sand and round stones ranging from an inch to twelve inches in diameter—the latter evidently intended to provide bulk and conserve cement, which must have been difficult to obtain at that time. The walls are eighteen inches thick, two stories high and withstood the earthquake of 1906. The attempt to imitate wood frame construction was wrong; but it can not be denied that the walls are substantial and durable.

Something Different

in *Cement Color Technique*

By J. C. WITT

Summary—*This paper outlines a procedure for preparing dispersed coloring materials for use with concrete and other plastics. It has some of the advantages of methods now in use, without their disadvantages. For example, facility of distribution is combined with permanency of color. The details are not presented, and it may be said that a number of problems remain to be solved. A start has been made toward providing a basis for the development of colored concrete considerably in adance of present practice.*

POPULARITY OF COLOR

EVERYONE knows that for the last decade or two the popularity of color has been firmly established in America. There is a growing appreciation and demand for color decoration of all kinds. If any proof of this statement were required, architectural journals and popular magazines, or a glance at bill boards, would furnish this proof. Thousands of articles, ranging from brush handles to automobiles, that formerly were seen only in black, white, or natural colors, now appear in many hues. Expressions such as *color-starved products, in every hue of the rainbow, the rising tide of color, a riot of color,* and the like, are prevalent.

COLOR in concrete has been a matter of constantly growing interest to architects, as well as to concrete contractors and products manufacturers. The subject-matter discussed in this instructive paper includes—

Popularity of color
Cause and Effect in the Demand for Color
Application of color to cements
Methods in common use for applying color to cements
Difficulties of color technique
Development of the colloidal process
Summary
References

Even if there had been nothing of importance to affect the trend of events since 1928, there is every reason to believe that color would have continued to grow in popularity. However, two powerful accelerators appeared — namely, the business depression and the Century of Progress Exposition. While, in itself, decrease in commercial activity has meant a corresponding decrease in the use of color, this has been greatly overbalanced by other factors. Buyers' markets and sharp competition have forced manufacturers to use more and more color—wherever color is applicable. It has become necessary to institute color surveys and censuses to learn favorite colors of individuals and various ages and races, and to determine the correct proportions of colors for many objects.

Color has been one of the most important features at the Century of Progress Exposition, as is evidenced by the appointment of a director of exterior color and a director of interior color. In turn, the Exposition has advanced color development to a degree that can not be estimated. According to an official publication,[1] "With an informal plan such as A Century of Progress Exposition is based upon, it is the color that ties the whole scheme together into one large composition. That is its essential purpose. However, it is not just color. It is color used artistically and intelligently." The following statement is from another current publication:[2]

"The first large-scale application of color in this country with an entirely new purpose, a new realization of its potentialities as an architectural medium, has been attempted at A Century of Progress Exposition. The problem was to co-ordinate and give vitality to a huge group of buildings of widely varying use and design, and it became the function of color to unify the whole scheme and articulate it to the best advantage. But to achieve this effect the treatment of color as decoration superimposed upon the architectural form was inadequate. The effort was made rather to employ color as a positive force.

"Hitherto, color in its relation to architecture having been used, in most cases, to fulfill a decorative, therefore subservient function, the usual palette consisted of shades and tones in gentle contrast. Since in this case the color was intended to make a positive contribution to the significance of the whole, it seemed necessary to employ a palette made up of the strongest, clearest, purest, most direct pigments available."

CAUSE AND EFFECT IN THE DEMAND FOR COLOR

In attempting to analyze the present color situation, one finds some little confusion of cause and effect. To what extent is the demand the result of natural development, and how much has it been influenced by advertising and publicity propaganda? We know that there have been extensive developments in photography and printing. Periodicals that formerly appeared in black and white only, acquired covers in color, then color gradually spread through the interior, first in advertisements, then in illustrations for fiction and non-fiction. This development enabled the producers of colored articles to picture them in color in advertisements. Competitors did likewise, and the movement increased to large proportions. No doubt this has been an important factor.

APPLICATION OF COLOR TO CEMENT

It is not surprising that, in common with other mate-

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*In this paper, the term *concrete* includes concrete proper, mortar, and stucco—in fact, any mixture containing cement.

rials, concrete* has become a medium for color expression. In general, such surface treatments as painting, spraying, and staining applicable to any material can be used with concrete. In addition, color may be introduced integrally into concrete and other plastics—either throughout the mix, or confined to an outer coat of any desired thickness. Other factors being equal, the advantages of integral over surface treatment corresponds to those of solid silver objects in comparison with silver plated ones.

It is obvious that the coloring of concrete is of interest commercially to color manufacturers. It is less obvious, but nevertheless true, that the matter is commercially important to the cement and concrete industries, because attractive appearance will favor the choice of concrete in competition with other building materials which can be less advantageously colored.

While color adds to the cost of concrete, in some instances it may result in a saving, indirectly. That is, it may supply a relief to a flat wall where otherwise expensive additional form work would be required. In discussing color at the Century of Progress, Teegan[3] says:

> "Color gives more interest to the flat surfaces comprising the walls of most of the buildings. The materials used have been adapted to a studied relation of mass and silhouette, but these areas are large and often unbroken. Without color they might be called almost austere and uninteresting."

METHODS IN COMMON USE FOR APPLYING COLOR TO CEMENTS

The principal procedure ordinarily employed for coloring concrete are outlined by Wilson[4] as follows:

> "The methods of coloring concrete may be considered in three classifications: first, the integral admixture of finely divided, inert color pigments; second, the use of colored aggregates which are exposed by some treatment of the surface after the mixture has hardened; third, surface treatments which may be further subdivided into penetration treatments and cover coats such as paints. The pigment admixture method is probably the most extensively used of the various methods listed. It is used in stucco, many pre-cast products, sidewalks, driveways and floors. The colored aggregate method has been used with conspicuous success in monumental structures and in cast stone, lighting standards, art marble and terrazzo, frequently in combination with pigments. The penetration processes have been applied to floors and tennis courts having a troweled surface. The use of paint coats on concrete is not greatly developed, though much has recently been accomplished in interior decoration by that means."

DIFFICULTIES OF COLOR TECHNIQUE

In general, the methods for applying colors to concrete are relatively simple, and there are many beautiful examples of concrete that have been so decorated. However, each method may be said to carry with it some disadvantage, or difficulty of technique. Surface color treatments may be considered temporary, although some have endured for long periods.

Of the various methods employed for coloring concrete integrally (not including colored aggregate), four may be mentioned: (a) cement colored during the manufacturing process, (b) grinding cement with small percentages of pigments, (c) dissolving dyes in the mixing water, and (d) adding pigments to the cement after the cement enters the concrete mixer, or previously.

The first of these has not been used extensively and it does not seem likely to the writer that the development along this line will be rapid or widespread. Probably the grinding of pigments with cement is the most satisfactory method in common use. It has the disadvantage, however, of cost. Rehandling and regrinding the cement, of course, adds materially to the expense. Dissolving colored materials in the mixing water is close to the ideal as far as convenience and distribution are concerned, but the materials available for the purpose are not constant in color and for that reason are not satisfactory. The last named is probably used more than the other three combined. Here, the difficulties that present themselves are imperfect distribution, and the undesirability of leaving too many details to laborers on the job.

DEVELOPMENT OF THE COLLOIDAL PROCESS

Familiarity with the shortcomings of the color procedures in common use, and some experiences in the colloid field, suggested colloidal colors to the writer. To combine the advantages of pigments and dyes seemed a set-up for colloids.

Before explaining the procedure that has been developed for introducing into concrete pigments in a very finely divided and dispersed condition—thus eliminating some of the disadvantages and combining some of the advantages of other procedures—a few words concerning the history of the development may be worth while. The matter was first suggested in an indirect way by the effect of sulfides on cement. An investigation of this problem disclosed that the effect varied with the quantity of the sulfide ion present, and with the percentage of iron in the cement.[5] This led to the synthesis of a highly colored green substance by warming a mixture of sodium sulfide and ferric oxide.[6] The substance proved to be iron in the colloidal condition in the presence of a relatively small quantity of sulfide.

When the substance was treated with water—the mixture containing less than one part of iron in ten thousand—the intensity of the resulting green color suggested its use as a coloring material for concrete. A few tests demonstrated, however, that the color is anything but permanent, and consequently possesses no commercial value.

No further work was carried on until a number of years later. In the meantime the use of color had greatly increased and the difficulties of introducing pigments integrally into concrete had become more apparent. Several years ago, an attempt to use coloring materials in the colloidal condition was made by the writer and, strangely enough, the results of this first trial were sufficiently encouraging to warrant an extended investigation. A long series of tests resulted in information which justified a patent application. The patent has been granted.[7]

Two inventions located by the patent investigation are of interest. De Ros and Barton[8] suggested the use of colloidal solutions for coloring cements and plasters, but the procedure for preparing the colloids included dialysis, and would no doubt involve considerable expense. Plauson[9] described the preparation of colloidal coloring by several methods, but did not suggest any application to cements.

These processes did not come to the writer's attention previous to the patent investigation, and as far as he knows they have not been used commercially. Essentially, the method developed by the writer consists in blending a pigment, a relatively small amount of cement, and a sufficient quantity of water and a protective colloid or dispersion medium, and passing the mixture through a colloid mill. The resulting material, which in this paper is considered the colloidal color, is dispersed in the water to be used in mixing cement mortar or concrete. Details to be determined include the fineness and other physical and chemical characteristics of the pigment selected, the nature of the dispersion agent, the relative proportions of all the materials, and the optimum operation of the colloid mill. Some of these details are common to all suitable pigments, while others are applicable to individual pigments only.

REFERENCES†

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†There has been no attempt to prepare a complete bibliography.

[1] Exterior color of the 1933 Exposition, Publication Division, A Century of Progress, Chicago.

[2] Muschenheim, William, The Architectural Forum, 59 (No. 1) 2, (1933).

[3] Teegan, Otto, Architectural Record, 73, 366 (1933).

[4] Wilson, Raymond, J. Am. Concrete Institute, 1, 616 (1930).

[5] Witt, J. C., Philippine Journal of Science, 11, Sec. A, 273 (1916).

[6] Witt, J. C., J. Am. Chemical Society, 43, 734 (1921).

[7] Witt, J. C., U. S. Patent 1,900, 216 (March 7, 1933).

[8] De Ros, D. and Barton, F., British Patent 269,974 (April 27, 1927).

[9] Plauson, H., U. S. Patent 1,458,542 (June 12, 1923).

Cincinnati Union Terminal Floors and Platforms Finished With Dry Hardener

Employ Principle of Water Extraction to Reduce Water-Cement Ratio—Dry Mixture of Silica Sand and Portland Cement Floated Into Surface

A NOTABLE instance of the use of a dry floor hardener applied during the construction of a heavy-duty concrete floor may be seen in the passenger platforms, passenger ramps (and stairs), vehicular ramps, the plaza terrace, the mail-handling building, and in the mail and express platforms, of the new Union Railway Terminal at Cincinnati.

Construction Procedure

In the construction of this floor the rough concrete slabs were brought up to the exact finish level and were screeded with long straight-edges. Immediately after the screeding, the dry surface hardener was applied with a sweeping motion of a shovel, completely covering the surface of the freshly-placed concrete.

As the dry material absorbed water from the fresh concrete slab, it was compacted into the concrete with heavy electric floats and followed up with the steel troweling. One laborer was easily able to spread the dry material fast enough to keep from eight to ten cement finishers busy. Where wet or low spots occurred, a little more of the dry hardener was applied.

For decoration, lines were cut into the surface of the passenger platforms after the work was completed. This was accomplished by means of abrasive wheels running at very high speed. The abrasive wheels selected for this purpose were 12 in. in diameter and were capable of cutting 500 lin. ft. by the time they were worn down to the hub. Some 250 wheels were required to cut the 25 miles of lines in the passenger platforms.

Nature and Purpose of Hardener

The dry hardening material applied to these floors, ramps and platforms, consists essentially of a silica sand which has been screened into its separate sizes and recombined in definite proportions of the several sizes, together with definite proportions of portland cement.

An important purpose of the dry hardener material was that of extracting water from the fresh concrete in the slab to which the hardener was applied. By extracting this water, the water-cement ratio of the freshly-placed structural concrete was reduced, and its strength was increased accordingly. The dry surface material, of course, utilized this extracted water in its own process of hardening, absorbing only as much water as was needed for this purpose. In this way it was possible to mix the slab concrete to a wetter consistency than if the hardener had not been employed, thereby aiding in the placing and puddling of the concrete.

Amount of Water Extracted

It is estimated that one sack (100 lb.) of the hardener will cover an area of 80 sq. ft., and that it extracts 12 pints of water to accomplish its own hardening. Where the structural concrete slab was 6 in. thick, an area of 80 sq. ft. contains about $1\frac{1}{2}$ cu. yd. of concrete. From this it will be seen that water to the amount of 12 pints ($1\frac{1}{2}$ gallons) was extracted from $1\frac{1}{2}$ cu. yd. of concrete, or at the rate of 1 gallon to the cu. yd. This resulted in an appreciable reduction in the water-cement ratio.

The dry floor hardener employed in the work at the Cincinnati Union Railway Terminal is known to the trade as "Maximent," and is produced by the Maximent Company, of Cincinnati. The material is supplied in 100-lb. waterproof sacks.

St. Louis Relieves Traffic with Express Highway

A 5-LANE express highway, 3 miles long, has been put under contract at St. Louis, for the purpose of relieving traffic congestion and speeding the movement of traffic. Cross traffic will be separated by means of 10 overhead highway bridges. Four pedestrian and one equestrian underpasses will also be built.

Precast Concrete Crossing Slabs Form Large Contract

792 Lin. Ft. in Ninth Street, Salina, Kans., Paved with Precast Units—Steel Reinforcement and Protecting Angles Shown

A CONTRACT of unusual size and importance for the class of work involved recently was completed at Salina, Kans., when 792 lin. ft. of precast reinforced concrete railway crossing slabs were placed as a part of the new pavement in Ninth Street, in that city.

Part of PWA Project

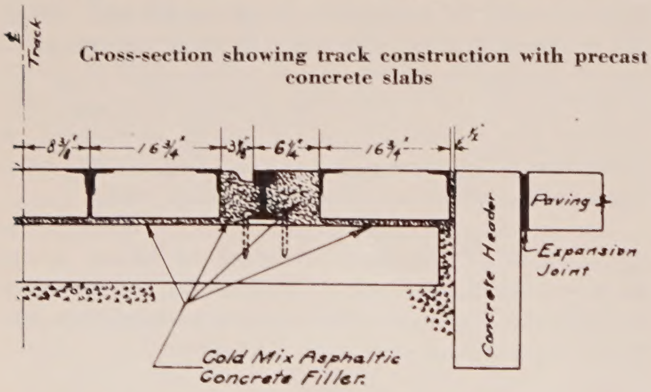
While the placing of precast concrete railway crossing slabs is not new, the size of this contract, the number of railroads involved, and the care taken in the design of the slabs and in working out the construction details, all are matters of interest to municipal engineers.

The work at Salina was part of a PWA paving project, the entire project having included the placing of a 6-in. reinforced concrete pavement in Ninth Street, in addition to the crossing slabs, which were included in the 30 per cent grant from the PWA.

Eighteen railway tracks cross Ninth Street within a distance of 792 ft. This was the part of the project involved in the contract for the precast slabs. The contract was awarded on May 3, 1934, to the H. J. Taylor Construction Co., of Salina, at $8.50 per lin. ft. for the total distance of 792 ft., while a special slab crossing was awarded to the same contractor at the lump sum of $950.

Reinforcement and Protecting Angles

The precast slabs are 16¾ in. wide, with a depth equal to the depth of the adjacent track rails. The length of the full slab is 6 ft., and that of the half slab is 3 ft. The slab reinforcement was made up complete, as shown in the halftone illustration, and for each slab it consists of four ⅝-in. round bars in the bottom, and the same in the top, tied with ¼-in. round loops spaced 6 in. apart. Each bottom bar of the main reinforcement forms a continuous loop with the corresponding top bar, the ends having been butt welded. Both theory and tests show that the anchorage of longitudinal reinforcement thus provided greatly increases the shear value of a reinforced concrete slab.

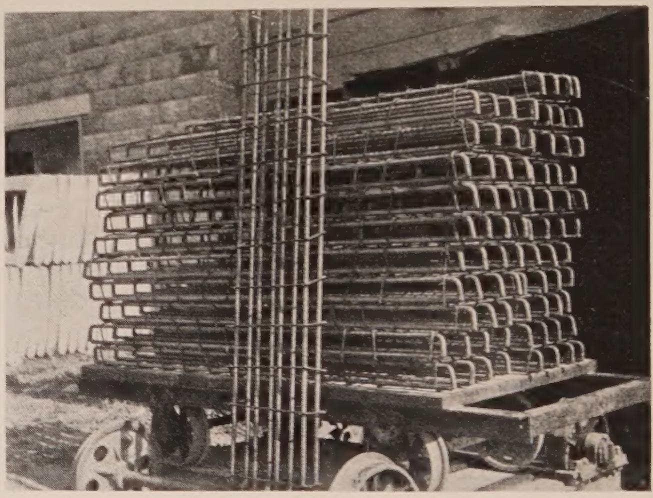

Cross-section showing track construction with precast concrete slabs

In addition, 2½ by 2 by ¼-in. structural steel angles were placed in the upper corners of the precast slabs, as shown in the line drawing. These angles were tied with ⅜-in. round bars spot-welded to the angles and spaced 18 in. apart.

Holes for the lifting devices were made with wrought iron pipe having an internal diameter 1/16 in. larger than the ¾-in. smooth round bars of which the lifting pins were made.

Use 3,000-Lb. Concrete

All concrete used in the precast slabs was specified as 3,000-lb. concrete having a minimum of 1.81 bbl. of cement per cu. yd. of concrete. The coarse aggregate was crushed stone of such size as to pass the 1-in. screen and be retained on the ¼-in. screen. The slabs were cast in an inverted position in molds lined with metal, the concrete having been placed under the influence of high-frequency vibration.

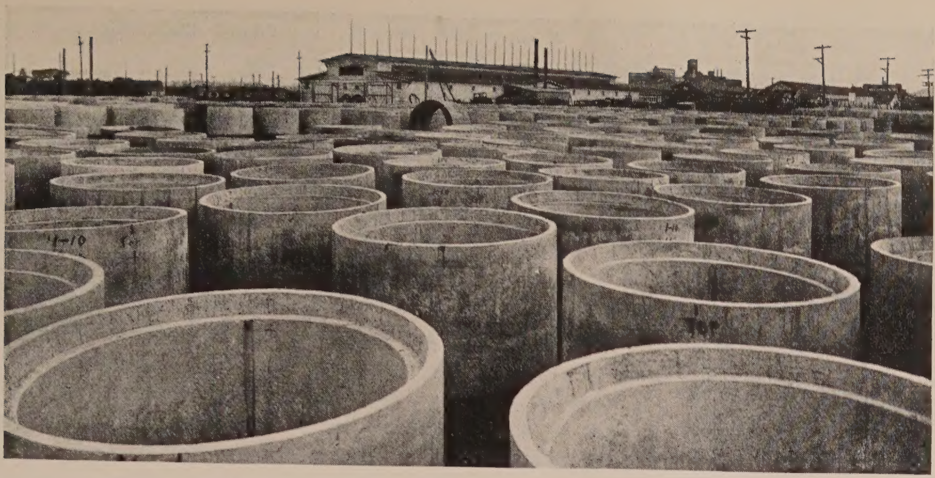

Prefabricated steel reinforcement for precast concrete crossing slabs

Track Construction

The track construction is shown in the line drawing, indicating the right half of a cross-section through a track. As here shown, a cold-mix asphaltic filler was employed as bedding for the concrete slabs, and to fill the spaces adjacent to the rails. Concrete headers 8 in. wide and 24 in. deep, cast in place, serve as divisions between the precast slabs and the monolithic pavement.

Acknowledgment. The precast concrete slabs were designed, detailed and installed under the direction of H. N. Lamme, city engineer of Salina.

Horace J. Young has been appointed acting district engineer in charge of the Lincoln, Nebraska, office of the Portland Cement Association, succeeding *D. D. Price,* former district engineer, who resigned to become chief engineer of the Platte valley power and irrigation district, North Platte.



More than two miles of 66-in. sewer pipe for part of sewer extension program at Spokane, Wash., were made by the Spokane Concrete Pipe Company

Concrete Sewer Pipe Has Long Record of Successful Performance

Milwaukee Installs 900 Miles of Pipe in 30-Year Period—False and Misleading Propaganda Fails to Stop Progress—Should Meet A. S. T. M. Specifications

THE extension and reconstruction of municipal sewer systems, stimulated in considerable measure by Public Works Administration loans, has brought renewed attention to the question of materials best qualified to stand up under the severe service conditions to which sewers are subjected.

Misleading Propaganda

Municipal officials charged with the selection of types or materials of construction for sewer systems often become confused by the mass of underhanded and misleading propaganda with which they are bombarded by interests opposed to the use of concrete pipe or monolithic concrete. Often this propaganda comes in disguised form, such as "consultation" or "technical service," the obvious intention being to conceal the fact that such "advice" is biased. With this point in mind, wise municipal officials will look behind the scenes to see the real source of the "advice."

For the larger tubes comprising the principal arteries of a sewer system, monolithic reinforced concrete has largely displaced the brick construction formerly employed, though in many sections brickwork is still being advocated. This article, however, is concerned mainly with the use of machine-made concrete pipe for sewer work, and with the false and unscrupulous propaganda often directed against this excellent material.

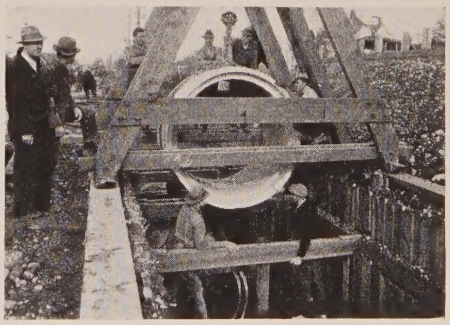
Some Guiding Facts

At the outset, it is well to enumerate the following facts:

(1) Practically all domestic sewage is alkaline in character. Waste acids from manufacturing processes discharged into a domestic sewer usually are too small in volume to change the character of the sewage, the acid being promptly neutralized by the alkalinity of the sewage. Sulphates, nitrates, chlorides and other salts are carried in solution in sewage, but these are not acid. In such cases only the laterals carrying acids from the industrial plant to the main sewer need be protected against damage from acid.

(2) Concrete pipe has been used successfully in the United States for building sanitary and combined sewers since 1842—the dawn of sanitary engineering as it is practiced today.

(3) The high strength and density of the concrete in machine-made concrete pipe renders this material immune from attack by any diluted disintegrating liquids that may at times be carried in sewage.



Showing how large sewer pipe units are handled and placed

(4) Concrete pipe (as well as monolithic concrete) is used today in every type of sewer—outfall, intercepting and lateral sewers—and has been so used since sewers were built in this country and abroad.

(5) Many cities, both large and small, have made extensive installations of concrete pipe sewers for many years. The experience of these cities supplies the best possible recommendation for this material.

(6) In many American cities—notably New Orleans, Houston and Toledo—vitrified clay pipe sewers which had collapsed or otherwise become unserviceable have been replaced by machine-made concrete pipe.

In regard to the first numbered paragraph above, verification of those statements may be found in authoritative engineering books such as Metcalf and Eddy's *American Sewerage Practice,* Vol. III, or in George W. Fuller's *Sewage Disposal.*

Acid Bugbear Kept Alive

A practical illustration of the manner in which the acid bugbear is kept alive and in circulation by interests antagonistic to concrete pipe may be seen in a case in Milwaukee. A 12-in. lateral of concrete pipe, leading from a large industrial plant and carrying an effluent containing approximately 0.5 per cent of sulphuric acid, became disintegrated. The lateral was replaced by, and at the expense of, the owners of the industrial plant.

This is the only instance of trouble with concrete sewer pipe in Milwaukee, although that city has placed *more than 900 miles of concrete pipe,* some of which has been in service for 30 years. Any city engineering department would regard this as a perfect record. Nevertheless, the clay pipe manufacturers had photographs taken of this alleged "failure," after which they retained a local engineer to make a report on it. The report and illustrations were printed and circulated all over the country, accompanied, of course, by wholly misleading deductions as to the significance of this minor incident.

This case is here mentioned in some detail, for the reason that it is typical of the thoroughly dishonest propaganda being distributed by the clay pipe interests. It shows clearly why engineers should pay no attention to outpourings of this character. If the facts in any given case are wanted, they can be obtained from the engineering department of the city in question.

Should Meet A. S. T. M. Specifications

Concerning the second and fourth of the numbered paragraphs above, engineering literature is replete with material that corroborates these assertions, so that nothing further need be said here.

As to the third numbered paragraph, reference need only be made to the standard specifications of the American Society for Testing Materials. It will be seen that the physical requirements there specified can be met only by concrete of the highest quality, placed by the most efficient methods known. In all cases local specifications for pipe should call for a product meeting the A. S. T. M. requirements.

Long Records of Successful Use

In corroboration of the assertion in the fifth numbered paragraph, concerning the long years of use of concrete sewer pipe in many cities, mention has already been made of the fact that Milwaukee has placed more than 900 miles of this type over a period of 30 years, for all types of sewers.

San Diego, Calif., has placed more than 300 miles of concrete sewer pipe since 1908, and since 1916 concrete pipe has been used exclusively for lateral sewers, house connections, and small interceptors.

Louisville, Ky., and South Bend, Ind., have made extensive installations of concrete sewer pipe, including sanitary sewers, since 1889. Louisville is just now completing a concrete sewerage system at a cost of $17,000,000.

Detroit has expended more than $60,000,000 on all types of concrete sewers, including concrete pipe and monolithic concrete. The Sanitary District of Chicago has similarly expended some $42,000,000. Spokane, Houston, Tampa and Toledo are among other large cities that have made extensive use of concrete sewer pipe.

Among the smaller cities, concrete pipe has been used for sanitary sewers in Bay City, Mich., and Nashua, N. H., since 1868; in Hudson, N. Y., since 1867; in North Adams, Mass., since 1874; in North Manchester, Ind., since 1881; in Racine, Wis., since 1883, and so on. The earliest use on record in this country was at Mohawk, N. Y., in 1842.

Does any one suppose for a moment that these cities, large or small, would continue to install concrete pipe sewers year after year unless the material were giving satisfactory service?

Made Under A. S. T. M. Specifications

Concrete sewer pipe is made under two A. S. T. M. specifications. The unreinforced pipe is made in sizes ranging from 4 in. to 42 in. internal diameter, under A. S. T. M. Standard Specifications for Cement-Concrete Sewer Pipe (Serial designation C14-24). This specification was first issued as tentative in 1917, was adopted in 1920 and revised in 1924. Reinforced concrete sewer pipe are made in sizes ranging from 24 to 108 in., under A. S. T. M. Tentative Specifications for Reinforced Concrete Pipe (Serial designation C75-30T).

Coatings Not Required

Both of these specifications were developed as the result of years of study and investigation, and the requirements are based largely on facts learned from inspection of pipe long in use. It is significant, therefore, that neither specification requires concrete sewer pipe to be lined with another material, such as bituminous coatings. In fact, such coatings have been proved worthless, when provided.

The statements just made are important, for the reason that the clay pipe interests have for years attempted to get municipal specifications written so as to require a bituminous coating on concrete sewer pipe. Sometimes they have succeeded. The obvious purpose is to place this additional manufacturing cost on the concrete pipe, thereby making it easier for clay pipe to compete. This phase of their propaganda cropped up quite recently, when the state engineers of the PWA in several states, for reasons as yet unknown, issued orders requiring concrete pipe intended for PWA projects to be coated. The controversy was finally brought to an end in one state through a letter from PWA headquarters at Washington, instructing the state engineer to leave to the city authorities the problem of selecting materials.

Considering the years of excellent service comprising the background of concrete sewer pipe, municipal officials can specify this product with the utmost confidence.

Concrete Pipe Manufacturers Meet

E. L. Warner of Spokane, Washington, was re-elected president of the Concrete Pipe Manufacturers at a two-day convention at Olympia, early in August. W. P. Hews, of Yakima, was elected secretary-treasurer and Hans Mumm, Jr., of Everett, vice-president.

◆ EDITORIAL ◆

Ready-Mixed Concrete Group in Membership Drive

EVERY business man is willing to recognize the favorable moral influence of the churches of a community, but not all of them are giving financial support to the churches.

Regardless of this tendency to "let others do the work," the National Ready-Mixed Concrete Association is making a determined effort to bring its entire industry into its membership, so that the burden of financial support will be more widely distributed.

Heretofore the financial support of the National Ready-Mixed Concrete Association has come from a mere handful of producers, who paid a sliding scale of dues ranging from $50 to $300 a year. The work of the association was effective, and it benefited every producer of ready-mixed concrete, including the big majority who contributed nothing to its support.

The association has now reduced its annual membership dues to $15, effective on July 1. If all producers of ready-mixed concrete will do their part by accepting membership in the association, the funds will be sufficient to carry on the work of distributing information, keeping up contacts with technical committees, and developing additional knowledge.

All the reasons which originally justified the formation of the association in 1930 apply today with greater force than ever. The development and acceptance of the industry's code of fair competition has brought additional duties and responsibilities to this group.

Each producer within the industry must decide for himself whether he will accept the benefits without assuming any responsibilities, or whether he will carry his part of the load.

Co-ordinating the Defense

FOR many years the leading competitors of commercial transportation on highways have centered their attacks on highway construction, doubtless having reasoned that fewer paved highways will mean fewer opportunities for the growth of highway transportation.

Economic conditions during the last four years have in many respects favored these attacks—often taking the form of attacks directed from sources that remained under cover. For example, there were the various state "taxpayers' associations," pretending to represent the general run of taxpayers, but financed, in fact, by the country's leading transportation interest and representing no one but their backers. Working tooth and nail for "highway construction holidays," they succeeded at least to the extent of seriously curtailing many a state road-building program, adding further to unemployment.

These same interests, no doubt, have done what they could to encourage the diversion of special highway construction funds such as gasoline taxes, though it must be admitted that our state legislator-politicians needed little outside help in this respect. The appropriation of special-use funds for other purposes is an art well understood by state legislators.

Only through co-ordinated effort have the friends of good roads succeeded in holding in check the various forms of attack on highway construction; and a vast amount of the credit for directing this co-ordinated effort belongs to the National Highway Users Conference. This organization, by supplying effective ammunition and showing the various highway-user groups how to shoot the ammunition, has performed a definite service to the highway construction industry.

Without this service the attacks on road building, damaging as they have been, would have succeeded in far greater measure, with far more harmful results.

Demand Concrete Walks Along Highways

CONSTRUCTION of thirty miles of concrete footpaths along fifteen important concrete roads in Milwaukee County, Wisconsin, recently was recommended to the state highway commission by the board of commissioners of the county.

William F. Cavanaugh, county highway commissioner, estimated the cost at $3,300 a mile. Similar paths built of cinder-bituminous mixtures earlier this year cost about $2,000 a mile. The county board offers the argument that unless the footpaths are made as inviting to walk on as the concrete pavement of the adjoining highways, pedestrians will not use them. In consequence, the cheaper construction is wasted.

What the commissioners say about pedestrians applies with equal force to bicycle riders. They, too, will take to the main roadway unless the path presents a riding surface equal in comfort.

Unquestionably the sudden wave of popularity accorded to bicycle riding will add a strong voice to the demand for concrete sidewalks or paths along highways in metropolitan areas. It matters little whether bicycle riding continues in popular favor or whether it dies out as a form of outdoor recreation for adults. The walks will always be needed and used by pedestrians and by children on bicycles.

Concrete sidewalks along metropolitan highways will reduce traffic accidents and traffic fatalities. As a convenience they are a definite necessity. Highway planners can not much longer ignore them.

PROGRESS—In a Page

Current activities in research, in matters pertaining to concrete and cement, as being carried on or completed by various organized groups.

Sulphate-Resisting Cements

THE proposed specification for sulphate-resisting cement, under preparation by the American Society for Testing Materials, was discussed in an article on pages 15 and 16 of the July issue of CONCRETE.

Some minor changes have been made by A. S. T. M. Committee C-1, and the proposed specification will be submitted to the Society before the end of the present year. In this specification attention is called to the fact that such cements may serve those purposes where a moderately low-heat-of-hardening cement is required. Chemical methods covering the more complete analysis of cements have been completed. The determination of fineness by means of the turbidimeter has reached a stage where the committee will submit to letter ballot a method covering the use of the Wagner turbidimeter.

The committee is also planning to revise and adopt as standard the tentative specifications for high-early-strength portland cement.

New and Revised Tentative A. S. T. M. Standards

THE 1934 annual meeting of the American Society for Testing Materials accepted 32 new tentative standards and revisions of 39 existing tentative specifications and methods of test. Following are the titles and serial designations of four of the standards—these four being related to cement or concrete:

(1) Method of Test for Compressive Strength of Portland Cement Mortars (C109-34T).

(2) Specifications for Sodium Silicate for Curing Concrete (C111-34T).

(3) Specifications for Non-Reinforced Concrete Sewer Pipe (C14-34T). This is a revision of an existing standard.

(4) Specifications for Reinforced Concrete Sewer Pipe (C75-34T). This is a revision of an existing tentative standard.

The A. S. T. M. now has a total of 219 tentative standards, including those accepted at the recent annual meeting.

A. S. T. M. Publications

IN addition to the regular annual *Proceedings*, the American Society for Testing Materials will publish, before the end of the present year, the following books:

(1) 1934 *Supplement to Book of Standards.* This will contain all standards adopted in 1934, and those in which revisions have been adopted. Copies of this book will be supplied without charge to purchasers of the 1933 *Book of A. S. T. M. Standards.*

(2) 1934 *Book of Tentative Standards.* This will be a compilation of all of the tentative standards of the A. S. T. M., in their latest form—a total of 245.

(3) *Combined Index to Standards.* In this volume, which is issued annually, will be found complete references to the latest publications in which the various standards and tentative standards are printed. This index is furnished to members, and to any others who request it.

Various other publications will be issued by the Society, but the three listed above will be of particular interest to readers of CONCRETE.

Revision of Standard Fire Tests

THE A. S. A. standard on Fire Tests of Building Construction and Materials, adopted in 1926, is to be revised to some extent.

As sponsors for the project, the National Bureau of Standards, fire protection group, and the American Society for Testing Materials, have concurred with the recommendations of the sectional committee concerning the approval of certain revisions of the document, approved in 1926 as American Tentative Standard, and the advancement of the revised document to American Standard.

Revise Specifications for Concrete Culvert Pipe

THE American Society for Testing Materials Committee C-13, on Concrete Pipe, expects to complete during the present year an important revision of the tentative specifications for reinforced concrete culvert pipe. The committee has obtained considerable test data from the various pipe manufacturers and highway departments, and the revisions are based to a considerable extent on the information thus received.

The present specification for reinforced concrete culvert pipe was adopted as a tentative standard in 1930, under the serial designaton of C76-30T.

Concrete and Concrete Aggregates

AMONG the large number of projects nearing completion by A. S. T. M. Committee C-9 on Concrete and Concrete Aggregates are an accelerated compression test of concrete, tests of vibrated concrete, procedure for the analysis of fresh concrete, a magnesium-sulphate test for soundness of aggregates, an absorption test of aggregates, method for determination of voids in coarse aggregates, specifications for light-weight aggregates, and an abrasion test for aggregates.

Federal Specifications for Special Cements

THE following federal government specifications have recently become mandatory upon the purchasing divisions of government departments:

(1) Silica Cement, listed under the symbol HH-C-176.

(2) Plastic Bituminous Cement, listed under the symbol SS-C-153.

Copies of these specifications may be obtained at 5 cents each from the Superintendent of Documents, Government Printing Office, Washington, D. C.

Special Cements in 1933

MINERAL Market Report No. 291, entitled Special Cements in 1933 (advance summary), may be obtained while the supply lasts by addressing the Section of Publications, U. S. Bureau of Mines, Washington, D. C.

Only one copy can be sent to the person applying, because of the limited edition.

Here Lies the *Market* for *Concrete Burial Vaults*

Map Discloses Location of 1,230 Concrete Vault Manufacturing Plants in United States—Developed and Undeveloped Locations Shown

THE map here illustrated, prepared by CONCRETE from thoroughly authentic sources of information, presents the concrete burial vault industry for the first time with a complete picture of its development.

Map of Vault Industry

Each black dot on the map represents the location of a plant engaged in the manufacture of concrete burial vaults, the number of individual plants in the United States totaling 1,230. The map discloses at a glance those sections of the United States in which the market is thoroughly covered; those in which a good beginning has been made; and those in which the concrete burial vault market scarcely has been touched. In this connection it is of interest to observe that in four states—Mississippi, Nevada, New Mexico and Wyoming—there are no concrete vault manufacturing plants in operation. In each of five states—Vermont, Rhode Island, Montana, Idaho and Arizona—only one plant is manufacturng concrete burial vaults. Yet in each of the states named in these two groups there are several cities of considerable size, providing sufficient population to furnish a worth-while market for a vault manufacturer.

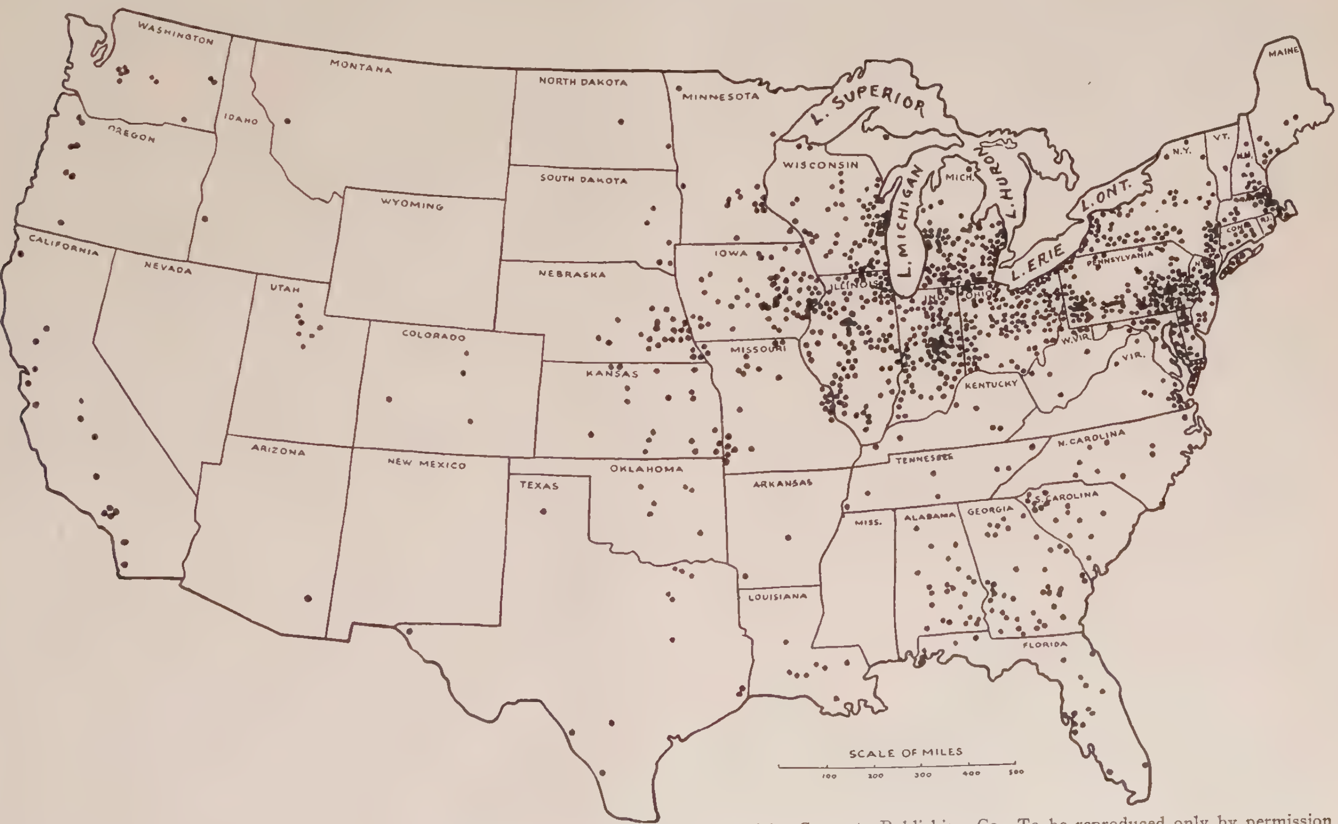
The Vault Market as a Whole

Before giving further consideration to specific localities, let us take a view of the general market for concrete burial vaults by quoting the following from an article on this subject in the June (1933) issue of CONCRETE, page 18:

"First of all, the number of deaths in the United States averages from 10 to 12 per year, per thousand of population. This rate seems to hold fairly well for all sections of the country.

"The volume of business (in any specific locality) will depend on the extent to which the steel vault has been established in the community, and on the percentage of people who continue to use the older type of wooden vault, or rough-box.

"Figures in our possession indicate that considerably more than 50 per cent of funerals in progressive agricultural and industrial sections now utilize either concrete



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The concrete burial vault industry. Black dots show locations of plants producing concrete vaults

or steel vaults, and that aggressive manufacturers of concrete vaults are actually selling their product for more than 50 per cent of the funerals in such communities.

"For instance, in a certain county in the fruit belt of Michigan there is one manufacturer of concrete vaults in the county seat, and one outside the county who ships into that territory. Even in 1932 these two manufacturers combined sold concrete vaults for more than 50 per cent of the funerals. Comparatively few steel vaults are sold in that territory.

"The Michigan county just mentioned contains no large centers of population. There is one town at the extreme end of the county that has a population of 5,000. The county seat has a population of 1,800, and four other towns have populations ranging from 1,600 down to 1,100. The population of the entire county is 32,600, and the number of funerals, per year, averages around 350. In a word, with its fertile farms and a number of villages and large towns, but no large centers of population, this county can be classified as a fairly rich agricultural community.

"A second illustration is a county in north central Indiana, with a total population of 29,000, the character of the population being partly industrial and partly agricultural. The county seat has a population of about 13,000, or about 15,000 with suburban areas included, and elsewhere in the county there are five or six towns with populations ranging from 500 to 1,000, and a number of smaller villages.

"There is one manufacturer of concrete vaults in this county—at the county seat—and his market is rather closely confined because concrete vaults are manufactured in every one of the surrounding counties. In the county seat and suburbs this aggressive manufacturer sells concrete vaults for 80 per cent of the funerals, while outside the city, throughout the rest of the county, he gets about 50 per cent of the total. No steel vault has been sold in the county since 1915, which speaks well for the merchandising ability of this products manufacturer as well as for the quality of his concrete vaults."

CONCRETE BURIAL VAULT MANUFACTURING PLANTS IN THE UNITED STATES

State	Number of plants	State	Number of plants
Alabama	23	New Hampshire	8
Arizona	1	New Jersey	29
Arkansas	2	New Mexico	0
California	16	New York	84
Colorado	4	North Carolina	9
Connecticut	9	North Dakota	2
Delaware	9	Ohio	123
Florida	18	Oklahoma	6
Georgia	40	Oregon	7
Idaho	1	Pennsylvania	161
Illinois	111	Rhode Island	1
Indiana	97	South Carolina	15
Iowa	57	South Dakota	5
Kansas	18	Tennessee	7
Kentucky	6	Texas	13
Louisiana	8	Utah	7
Maine	8	Vermont	1
Maryland	20	Virginia	25
Massachusetts	26	Washington	10
Michigan	91	West Virginia	11
Minnesota	15	Wisconsin	76
Mississippi	0	Wyoming	0
Missouri	25	Dist. of Columbia	1
Montana	1		
Nebraska	23		
Nevada	0	Total	1,230

The Ultimate Annual Sales

It can not be expected that the ultimate annual sale of 10 to 12 per cent of the total population, or 1,250,000 to 1,500,000 vaults, will ever be fully realized. In some sections of the country the population is spread out too thin to provide a profitable market within the shipping radius of a plant. In other sections the greater part of the population is not sufficiently prosperous to afford this luxury, as they regard it. But from the two cases cited in the foregoing quotation, it is clear that a large market may be found in rural communities that are even fairly prosperous, although our cities and larger towns will probably continue to supply the better sales outlet. The case of the manufacturer in north central Indiana, who sells concrete vaults for 80 per cent of the funerals in the city and for 50 per cent of those in the country districts, may be taken as a market guide for plants located in fairly prosperous industrial and agricultural sections.

Where Market Is Most Highly Developed

The map discloses what might be expected, namely, that the industrial sections of the east, the middle west, and the southeast, are the sections in which the concrete burial vault market has been most fully developed. Yet the first impression gained from a study of the map may be misleading. For instance, a prospective manufacturer might come to the erroneous conclusion that in states such as Massachusetts, New York, New Jersey, Delaware, Maryland, Pennsylvania, Ohio, Indiana, Illinois, and Wisconsin, no further opportunities exist—that the entire market is covered by existing manufacturing plants. This is not the case, as a more careful study of the map will soon disclose. It will be seen that in each of these states certain areas contain no plants.

In some instances these bare "patches" are in the more thinly populated sections of the state, but that is not true in all cases. In Indiana, for example, there are 97 plants —an average of more than one to a county—yet no plant is located anywhere in Howard County (population 46,696 in 1930), of which the principal city is Kokomo (population 32,680). Here is one of many locations which some one is overlooking.

Even in Pennsylvania, the state in which the density of concrete vault manufacturing plants is the greatest of all (with its total of 161 plants), similar "bare patches" exist. While, in general, these are in the less populous areas, some good markets in that state remain untouched. One case is that of Clearfield County, with a total population of 86,727 in 1930. Clearfield, the county seat, had a population of 9,211 in 1930.

Markets Partly Developed

Reference to the map and the table will disclose the surprising fact that many large markets have only begun to be developed. Consider California, as one example, with only 16 plants in the entire state, located in eight cities and five small towns. That state contains 23 cities having populations of more than 20,000. Many other communities not now covered would provide ample markets for a plant.

Colorado contains only four plants, two of which are located in small communities. Six other cities, with pop-

(*Continued on page 26*)

How to Obtain Modernization Loans Through National Housing Act

Men of Construction Industry Must Sell Ideas to Owners of Residential and Business Properties—Questions and Answers Give Essential Facts About Law

NO one can expect that owners of homes and business property will, on their own initiative, rush to the nearest bank or building and loan association and start negotiations for a modernization loan based on the National Housing Act passed in the closing days of the last congress.

On the contrary, salesmanship will be required—not the ordinary kind of salesmanship that sells goods over a counter, but the kind that sells ideas. This salesmanship must come from architects, from concrete products manufacturers, from engineers and from contractors, acting both as individuals and in building industry groups.

Business Properties Included

To begin with, the name of this Act—the National Housing Act—and the newspaper publicity that has been devoted to it, have given the public the impression that the Act is concerned chiefly with the renovation and modernization of *homes*. This impression is as wrong as it is unfortunate, for the Act specifically applies, not only to individual homes, but to two-family houses, to apartment houses and other residential buildings, and to business buildings such as store buildings, commercial garages, office buildings, warehouses, farm buildings, and factories.

Give Facts to Public

It is necessary, therefore, and very important, that this wider scope of the National Housing Act be brought to the attention of each community. This may be done through newspaper articles in the local press, through meetings of business men, and through personal calls on property owners who have business buildings that need repair.

The spread of this more accurate knowledge about the scope of the National Housing Act is a duty and a responsibility that must be accepted by the men of the building industry, for it is probable that more substantial contracts and commissions will come through the repair and remodeling of factory and business buildings than through the remodeling of homes. In the case of commercial buildings, there is the added inducement of increased income or increased business as a direct result of the improvement.

Considering Individual Cases

The man who owns a retail store building with a drab or dilapidated front and a shabby interior can be convinced that a new store front, a new tile floor, and a refinished interior, will draw more customers and increase the business volume of that store. The owner of a factory must be shown how he can improve the quality of his product and increase the average output per employee by providing a better-lighted workshop and more sanitary working conditions.

Facts About the Housing Act

The foregoing suggestions indicate only a few of the many ways in which the owner of a factory or a business building may be approached. However, the person approaching him must be well informed himself. It is, therefore, the purpose of this article to set forth, in question-and-answer form, some of the high points of the National Housing Act, so that most of the property owner's questions may be anticipated and answered. In the numbered paragraphs that follow, the question appears first, in *italics*, followed by the answer, in ordinary type.

(1) *Who may apply for a loan?* Any property owner, individual, partnership or corporation, with a regular income from a salary, commissions, business or other assured source.

(2) *May the owner of any kind of property apply?* Applications will be considered for one-family, two-family, or other residences; apartment buildings, stores, office buildings, commercial garages, factories, warehouses, farm buildings.

(3) *To whom is the application made?* To any national bank, state bank or trust company, savings bank, industrial bank, building and loan association, or finance company approved by the Federal Housing Administration; or to a contractor or building supply dealer.

(4) *Is it necessary to own stock in the building and loan association or other loaning organization?* That is not necessary.

(5) *How much may be applied for?* From $100 to $2,000 on any one property, and like amounts in connection with each one of not more than five properties.

(6) *How long may notes run?* For any number of months from one to three years. Notes extending from 37 months to five years may be submitted to the Federal Housing Administration by financial institutions for special consideration.

(7) *What security is required?* Only that the borrower has an adequate regular income and a good credit record.

(8) *What assurance must be furnished with respect to the legal status of the property?* (a) The borrower must own the property, or have control of it as lessee. (b) The annual income of the borrower must be at least five times the annual payments on the note. (c) If a mortgage exists, it must be in good standing, and there must be no back taxes, unpaid interest or liens against the property. Or, if mortgage payments are overdue, or a lien exists, this obstacle will not prevent the granting of a loan if the note is endorsed by the holder of the mortgage or lien. (d) Assurance must also be given that the money borrowed will be used for the improvement of the property.

(9) *What signatures are required?* The signature of the property owner. If the borrower is an individual and

is married, the signature of the wife or husband also is required. No other co-signers or endorsers are required.

(10) *How is the note paid?* By making regular equal monthly payments (or seasonal payments in the case of farmers or others having seasonal incomes) until the note is paid in full.

(11) *To whom are payments made?* To the financial institution from whom the loan was obtained. No payment is made to any government office or organization.

(12) *What is the cost of this credit?* On a one-year note, 5 per cent of the face value of the note. Thus if a borrower obtains a loan of $300 for one year, the financial institution may collect 5 per cent, or $15, in advance. The borrower, therefore, actually receives only $285; but the $15 deducted is to cover interest and fees of all kinds, and under no pretext will the loaning agency be allowed to collect more. The charges for loans running longer than one year will be proportional to the charges for one year.

(13 *Does the note bear interest?* The note does not bear interest. It will be seen in the answer to question (12) that the interest is collected in advance. In the example there given, the borrower makes twelve monthly payments of $25 each, or $300 in all. He pays no further interest.

(14) *How does this cost compare with other possible sources of loans?* Compared with ordinary commercial bank loans running 60 to 90 days, the cost is higher. Compared with the same type of loans payable in monthly installments, the cost is much lower.

(15) *May the fees of architects or engineers (for preparing plans) be regarded as a part of the cost?* Such fees may be regarded as a part of the cost and may be included in the estimate accompanying the application for a loan.

Checking Up on Residential Property

When an architect, a products manufacturer, an engineer or a contractor approaches a property owner for the purpose of selling the latter the idea of improving his property, he should have at the tip of his tongue the answers to the questions given above. He should also have in mind what points to look for during the examination of a property. Thus in the case of a home or other residential property, he should check up on the following:

(1) Starting in the basement, is the first floor sound?

(2) Are the basement walls leaky and in need of repair? Is a concrete floor needed?

(3) Is the basement just waste space? If so, it may be converted into recreation space or working space.

(4) Looking at the outside, does the stucco need patching?

(5) If the exterior walls are of old masonry, partly disintegrated, a coating of cement stucco will save them.

(6) If the old steps are decayed and dangerous, concrete steps should replace them.

(7) Concrete walks and garage drives may be needed.

(8) The chimney may need repointing or reconstruction.

Examination of Business Property

In the examination of business property, the points to keep in mind are the possibilities for a direct increase in income from rentals, an increase in usable floor space, and (in the case of a retail business) for attracting the favorable attention of shoppers and thus increasing the volume of business. In consequence, the following are a few to watch for:

(1) Rentable or usable basement areas can be increased by rearranging the service space, building new partitions, providing ventilation, finishing walls and floors, and building new stairs.

(2) Are the maintenance shop and storage spaces convenient, well lighted and properly equipped?

(3) A sidewalk lift might improve the efficiency of the property.

(4) Damp basement walls and floors may be waterproofed or re-surfaced.

(5) Better washroom and plumbing facilities, located in modern quarters, may add to the comfort and efficiency of employees.

(6) Coming up to the street floor, it may be quite obvious that a new and modernized store front is a crying necessity.

(7) The interior may be in need of redecorating—or perhaps there are sagging floors and ceilings that need leveling up or replacement with new floors and ceilings.

(8) Lobbies of office buildings, apartment buildings and related types of occupancy may be dark and dingy. They create a first impression that is extremely unfavorable. Such lobbies can be made bright and attractive with new wainscoting, resurfaced or tiled floors, and modern light fixtures.

(9) Customers, clients and tenants are inclined to pay more for products or for services if the place of business is attractive, comfortable and convenient.

Check Lists Not Complete

The foregoing suggestions can not be regarded as complete check lists; but they constitute a start. Anyone who is familiar with building construction will recognize quickly any other features that will add to the value of a business building, a factory, an apartment building, and so on. Some work will involve rearrangement or replacement, as with store fronts, lobbies and first floors.

Finally, write to the Federal Housing Administration, Washington, D. C., for more complete information telling how owners of residential or business property may obtain the benefit of the National Housing Act.

Building Revival Forces Gaining Strength

THE *Brookwire* report of August 27 states that while building is slow, they believe the fundamental basis for revival is gaining strength. "The building industry has passed from spring into midsummer with little change in tempo. On the whole, the rate of building activity has run on an even keel at a level moderately above the low point of the depression.

"The semi-annual survey of the National Association of Real Estate Boards," they say, "confirms the belief that real estate conditions are gradually improving, even though some property is still changing hands at low prices. The demand for space has improved and rents are showing a tendency to rise. A condition of shortage in small homes is becoming more widespread. Unfortunately, the building season is too far advanced to permit any great volume of activity this year.

"Some decline in actual building costs is apparently under way. While the utterances of national union leaders are insistent that wage cuts will not be tolerated, evidence is beginning to appear that a more reasonable attitude displayed in local negotiations is resulting in reductions which will stimulate new building next spring."

Control of Ready-Mixed Concrete by Trial Mixtures

Procedure Followed in Maintaining Control of Quality and Yield—Laboratory and Job Records and Laboratory Equipment

By K. M. McKELVEY
Concrete Technician, Butler, Penna.

IN the first part of this article, printed in last month's issue of CONCRETE, simple rules of procedure are given for the design of concrete mixtures. This concluding installment covers the methods followed in the actual field control of quality and yield.

NOTES ON CONTROL

As a result of the trial mixes, a collection of average data has been assembled on which to base the system of mixes. Methods of control must now be devised to take care of major variations in materials and operations reacting on the quantity and quality of concrete.

Quantity Control

Fluctuations may occur in actual yardage, due to the following factors—

(1) Variations in the specific gravity of aggregates.
(2) Per cent of moisture carried by aggregates.
(3) Amount of mixing water used.
(4) Carelessness of operation.

The quantity of aggregate set up for a yard of concrete is of major importance in the economy and frictionless operation, as regards the customer of the plant. The weights used for a yard of concrete should be capable of complete justification to the customer by specific gravity formulas, trial mix and "yard box" data.

There is some criticism of the measuring stick being in volume rather than in weight. In my opinion it offers the measure demanded by the user, affords a ready check on the job and is capable of easy translation to weight figures, as desired.

Variations in Specific Gravity

If we take 2 per cent as the maximum guaranteed variation in the scales (representing approximately ½ cu. ft. of concrete) let us examine the variations due to other factors to see how they compare with this mechanical efficiency.

(1) Variations due to a change in the specific gravity of aggregates occur mainly where the materials lack a homogenous origin, illustrated by dredged river materials or where coarse aggregates of different origins such as slag, gravel and stone, are used. A change in the specific gravity causes a direct variation in the absolute volume resulting and thus affects the yield.

The S.G. of the materials used in the trial mixes having been noted, tests on materials in use will detect any variations in their S.G. which may affect yield. Where its value is known and uniform, the S.G. of the component offers a ready and accurate means of checking quantities and figuring new mixes.

Whether this factor should be a part of the control system depends upon the extent of its variation from the average. As an example, with a mix having 1,050 lb. of dry sand and 2,150 lb. of dry gravel, a variation from 2.55 to 2.65 in S.G. will produce an alteration in yield of 0.25 cu. ft. (sand) and 0.50 cu. ft. (gravel). This totals 0.75 cu. ft., a factor not to be neglected.

In practice, this yardage figured by S.G. formulas checks that obtained by trial mixes and on the job very closely. Usually the difference of 0.1 to 0.2 of one per cent is in a greater actual yardage because of included air voids.

Changes in Moisture Content

(2) Variations due to changes in moisture content of the aggregates occur at all plants where materials are not stored under cover. In materials taken directly from barges or stored in open stock piles I have obtained variations of 2 to 10 per cent in the sand and up to 4 per cent in the gravel in a day's operation.

If we now take our mix (1,050 lb. of sand and 2,150 lb. of gravel) and apply these percentage variations, we might get from 21 to 105 lb. of fluctuation in the sand and up to 86 lb. in the gravel. This results in the substitution of water for aggregates and would amount to 0.5 cu. ft. of resultant concrete for each, assuming a constant S.G. of 2.60.

Variations in Yield

(3) Variations in yardage due to the amount of total water required to produce a given slump may occur. Thus, for a change in slump from ½ to 8 in., about 6 to 10 gallons of water are needed for a yard of concrete. This represents 66½ lb., or about 1 cu. ft. of concrete.

Of course, with the higher slumps some of this water is excluded from the concrete on carriage and placement, and does not necessarily result in water voids. Probably this factor is from 0.5 to 0.75 cu. ft.

TABLE 3—POSSIBLE VARIATIONS IN YARDAGE

Due to	Total	Per cent	Per cent of variation from mean
Specific gravity	0.75 cu. ft.	2.8	1.4
Moisture	1.00 cu. ft.	3.7	1.9
Consistency	0.50 cu. ft.	1.9	0.9
Total	2.25 cu. ft.	8.4	4.2

Careless Operation

(4) Variations in yardage in operation may result due to a number of causes, mostly arising from carelessness of the operator. Scales are usually guaranteed to an accuracy of 2 per cent, although if poorly maintained and

adjusted the error will be much greater. An operator who does not care for the scales allows accumulations of materials in weighing hoppers. If he does not watch the tell-tale dial closely he may cause variations in quality and yardage greater than all the above causes.

The extremes of variation cited above are severe, and do not generally all occur at one plant. They can occur, and have occurred in my experience under certain conditions of supply, as with the use of river sand and gravel deposits where the S.G. was uneven because of differences in geologic origin, and the moisture conditions were unusual because the materials were used directly out of barges and were dug only a few days before.

The steaming of materials in the winter time also accounts for an uneven moisture content (3 to 8 per cent), often through a single day's operation. The moisture present will depend on steam pressure and duration, shape of bin, etc., and may be controlled to some extent by an intelligent study of these factors.

A plant in another district utilizing a bank sand and rock for its staple aggregates had variations of much smaller range, as shown in Table 4.

TABLE 4—VARIATIONS WITH BANK SAND AND ROCK

	Sand	Rock
Specific Gravity	2.60-2.65	2.59-2.61
Moisture*	3-6 per cent	0-1 per cent

*Except where materials were steamed.

At this plant the control was concerned mainly with moisture tests, with occasional checks on characteristics of aggregates from different sources.

CONTROL TESTS

In those cases necessitating control measures—that is, where the variation from a mean exceeds 1 per cent—there are several quick and accurate tests which may be applied. The equipment for these tests is inexpensive and, indeed, may be easily improvised.

The tests for S.G. may be based on the well known formulas—Approximate Apparent S.G. = Weight in Air ÷ Loss of Weight in Water. Approximate Apparent S.G. = Weight in Air ÷ Displaced Water.

(1) Weigh coarse aggregate (A); fill with water to top of container, weigh (B); weight of container filled with water only, a constant (C).

Then, S.G. $= A \div C—(B — A)/62.5$.

This test requires the use of scales and a graph for plotting the effect of constants and requires a little more time than is available for a control test.

(2) Fill a wire cage with the coarse aggregate to be tested. Weigh in air (A), submerge in water and weigh (B).

Then, S.G. $= A \div (A — B)$.

This test requires a special set-up of scales and bath. It also requires the use of a graph for quick reading. It is a little faster than the above, but requires more room, a valuable quantity on the usual charging floor.

(3) Take a container, fill to marked volume well above the level of coarse aggregate, with water (A), pour in a marked volume of coarse aggregate (whose weight will be assumed to be constant) (B), note change in water level (D).

Then, S.G. $= B \div (D — A)$.

This method is less accurate than either of the above but gives results within a reasonable margin of error. It requires very little apparatus, and the container can be made self-reading by graduating it at the top in the necessary weight corrections.

The accuracy of the test is also dependent on the ratio of the height of the cylinder to its diameter. These tests are only approximate because the factor of absorption is not taken into consideration.

Moisture Tests. Probably the test used to the greatest extent is the drying test. Drying the sand with burning alcohol is the fastest method. This test is too slow where results are needed a minute after the sample is taken. It is also necessary to make an approximation for the absorption in order to obtain the free water.

The salinity device has some advocates. This instrument measures moisture by its effect on the salinity of the mixture of moist sand and pure water.

The Chapman flask is probably the most accurate method marketed but requires the use of scales and chart.

For some time I have used a very simple device which gives adequate results. The device consists of a 500 c.c. plain glass cylinder. The cylinder is filled to a mark on the glass with water, the moist sand sifted in until a certain constant volume marked on the glass is read. The water level has now reached a new level proportional to the moisture in the sand.

These displaced levels are graduated directly in number of gallons of moisture present in an average quantity of sand for one yard of concrete, and thus are self reading. The method is based on the principles—

(1) The volume of inundated sand having approximately similar sieve analyses (voids) is the same.

(2) The displaced water represents voids in the sand (A), the absolute volume of sand (B), and the moisture present in the sand. A and B are constants with careful manipulation, and the extra or displaced water is the moisture.

This device takes only a minute or two to operate, and has been in successful use where moisture conditions necessitated a test on every other batch.

QUALITY CONTROL

If concrete is to retain its present high status in structural engineering it must be capable not only of attaining a given strength but of maintaining a degree of uniformity which will justify a design based on that strength. Then, an industry based on the production of concrete will reach its greatest fulfillment in attaining this stable product, and the individual plant furthest along the road of control will reap the ultimate benefits.

Quality control should cover the following—

(1) Total water for a yard of concrete.
(2) Material tests.
(3) Tests of the finished concrete.

Control of Water Quantities

(1) The control of the total water in a yard of concrete is essential to the production of a uniform product of good strength. Modern research in concrete has demonstrated, and numerous individual tests have corroborated, the large part that the relation of the water to the cement plays in the compressive and transverse strength of concrete.

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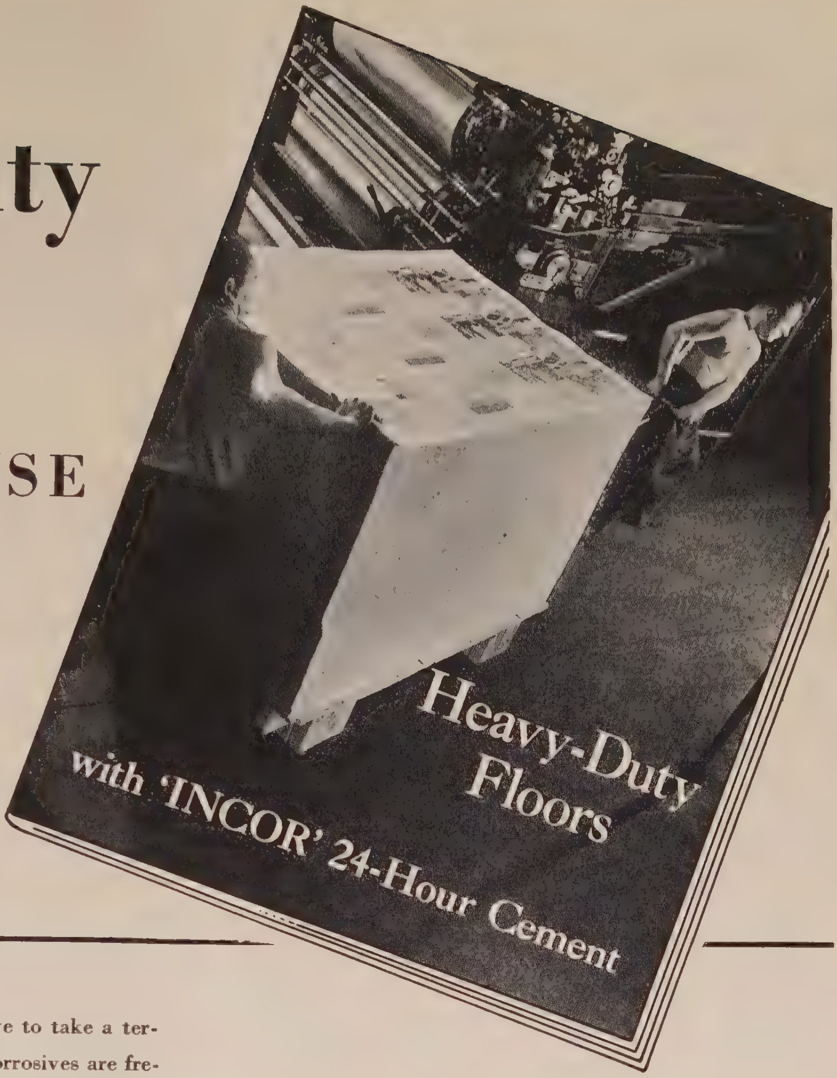

Most industrial floors have to take a terrific 'beating.' Steel-tired trucks, acids and corrosives are frequently encountered. So, in addition to adequate strength, a heavy-duty concrete floor also has to have exceptional durability. That means good materials and skilled workmanship—and, above all, adequate curing.

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Please say, "I saw it in Concrete"

Water control serves these purposes—

(a) Secures a given uniformity of strength.

(b) Insures that the consistency and workability will be that ordered by the customer without leaving this up to a driver who may or may not understand the job requirements.

(c) Offers the only logical base for the quality record.

Simple moisture tests have already been given. A word about the relation of the total water required for a yard of concrete to the major variables of mix, slump and size of aggregate, may be of interest.

The chart designated as Table 5 shows the characteristic change in total water requirements for different slumps, mixes and sizes of aggregate.

TABLE 5—WATER CHART

—Mix—		Gallons for 1 cu. yd.				
Aggregate	Slump	1-3-6	1-3-5 1-2½-5	1-2-4	1-2-3	1-1½-3
¾-in. gravel	2-4 in.	36	34	36	38	40
	4-6 in.	37	35	37	39	41
	6-8 in.	38	37	39	40	42
1½-in. gravel	2-4 in.	33	31	33	36	38
	4-6 in.	34	32	34	37	39
	6-8 in.	35	34	36	38	40
2½-in. gravel	2-4 in.	31	29	31	33	35
	4-6 in.	32	30	32	34	36
	6-8 in.	33	32	34	35	37

Experiment having determined these total water demands for a given district, any observable variation will be due to grading, dirty materials, or careless operation, and may be more easily detected.

This total water requirement for a unit volume of concrete offers a valuable region of practical research which would be of benefit to the industry. As can be seen by the above chart, there are definite relations between the total water and the different variables. A long series of tests, or investigation of present data with this relation in mind, could be made.

Testing Materials

(2) A regular program of material tests should be inaugurated covering the different sources.

Cement is quite generally tested in the ready-mixed industry. The testing of cement is necessary, not only to check on the product, but to obtain information as to certain properties of the different brands which make them particularly valuable to this type of concrete. The mortar compression test offers a valuable test as to the availability of different brands for strength concrete.

The coarse aggregate must be tested for grading, weight per cubic foot and cleanliness, at frequent intervals. The fine aggregate must be tested for grading, weight per cubic foot, organic impurities, and silt. The last two tests may be combined in one for control purposes by observing the amount of silt settling at the top in the standard hydroxide test for organic impurities.

The necessity for the frequent use of the above tests is determined by the special characteristics of the materials used and their uniformity and trustworthiness of source.

(3) The test of the finished product should consist of a complete program of compressive tests (transverse tests for road work). The strength tests are of the greatest value, for they offer not only a gauge for the quality of the product, but also the data to be obtained by a visual examination of the break, such as break around or through the aggregate, shear or bond failure, character and distribution of the matrix, etc.

LABORATORY RECORDS

The quality record of the cylinders should be complete and tied in closely with the job data record. Samples of both these records are given in Table 6. The program of cylinders to be taken should be planned in advance to cover the range of cement content, W/C ratio and size of aggregate available.

TABLE 6—HEADINGS FOR LABORATORY AND JOB RECORDS

Quality Record

No.	Date	Mix	Break			Character of concrete	Pct. of sand in mix	W/C ratio
			Strength		Type of failure			
			7-day	28-day				

Job Data Record

No.	Date	Mix	Job	Contractor	Quantities (Weight and identification)				Strength	
					Cement	Sand	C. Agg.	Water	7-day	28-day

A quantity record of yield as determined by trial mixes, job measurement, and with the "yard box," must be kept.

The plant control records should be kept for future reference as occasion arises, as well as the identification of the materials used. On extensive operations, the weights of loads should be obtained at intervals with the yard scales and reported daily to check up on the accuracy of the weighing.

The plant laboratory is the proper source of data for accounting purposes. A record of production filled out every day with quantities of materials used is found to be of valuable assistance in obtaining costs of production and for pricing.

LABORATORY EQUIPMENT

The minimum equipment that a ready-mixed concrete plant laboratory should have is as follows:

Cubic-foot box.

Platform scales—capacity 300 lb.

Sand sieves—

50-30-14-4 or ⅜-in. mesh, the last named depending on size of the sieve separating fine and coarse aggregate.

Or—

50-20-8-4 or ⅜-in. mesh.

Coarse aggregate sieves—

¾-1½-2 or 2½-in., the last-named size depending on the maximum size.

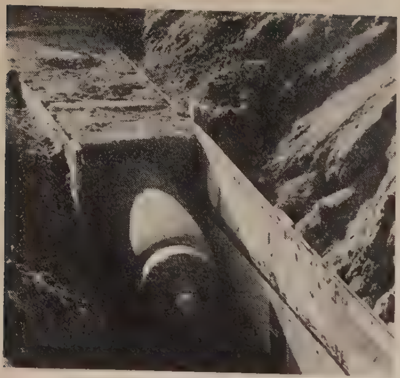
Mixing pan, 4 by 4 ft.

Balance or volume container.

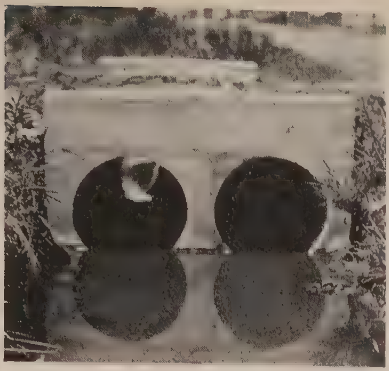
16-oz. prescription bottle.

Light-Weight Concrete Units in U. S. Military Academy

An order for light-weight concrete building units equivalent, in volume, to 130,000 standard 8 by 8 by 16-in. units has been placed by the construction quartermaster section of the War Department through the J. A. Mahlstedt Company, of New Rochelle, N. Y., for the addition to the gymnasium at the U. S. Military Academy at West Point. The units are being made with "Pottsco," a slag aggregate, and represent one of the most important orders for this type in the eastern territory.



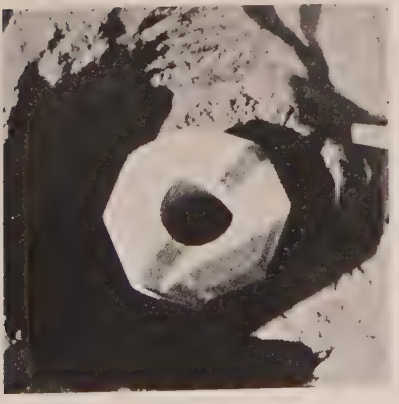
Shows a twelve inch Flexicore (inflated) as used in sewer construction



Shows two eighteen inch openings in highway culvert formed by Flexicore

Shows 3" porous concrete tile used to drain subgrade under pavement slabs

Shows same Flexicore as in top picture when deflated. Note complete detachment from concrete



Shows head of 24" octagonal hollow concrete pile after driving to a depth of 35'-10" with 466 hammer blows. (13 ton hammer, 9,000 lb. ram). Ten inch hole formed by Flexicore

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NEW FLEXIBLE FORM

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The inflated core is placed in the designed location in plastic concrete. When the concrete has set, the core may be deflated and easily withdrawn, coming out clean and ready for immediate re-use. The combined decrease in diameter and increase in length positively breaks the bond between the core and concrete and is the reason why FLEXICORE is so easily removed.

FLEXICORE makes possible the construction of ducts, conduits, or other circular openings in sizes from ONE inch to TWENTY-FOUR inches, any desired length. When shipped for field use, the core is equipped with end fittings suitable for air or water pressure at the users option. Joints, the weakest points in ducts or conduits built of precast units, are entirely eliminated by this method. Smooth curvs with perfectly round ducts can be built without the use of special shapes or forms. FLEXICORE also lends itself perfectly to the vibration of concrete and to reinforcement for bridging soft spots to maintain alignment.

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Use of Dark Colored Concrete Adds to Effectiveness of Highway

Dark Colored Center Lane Reduces Glare—Keeps Traffic Automatically in Line—Enhances Attractiveness

THE State Highway Department of New Hampshire has just completed a three-mile concrete road upon its route between Nashua, N. H., and Lowell, Mass. This modern three-lane road is unique in that the center lane is of dark colored concrete.

Dark color was chosen for that portion of the center lane slab lying above the plane of steel reinforcing. It was tried as an experiment in traffic control, and it serves its purpose admirably. Traffic automatically stays to the right except when overtaking and passing another vehicle. In addition, the glare of the sun is appreciably reduced. Furthermore, there is less pavement reflection from the lights of an oncoming vehicle at night. The general appearance of the road with its distinctive three lanes is considerably enhanced.

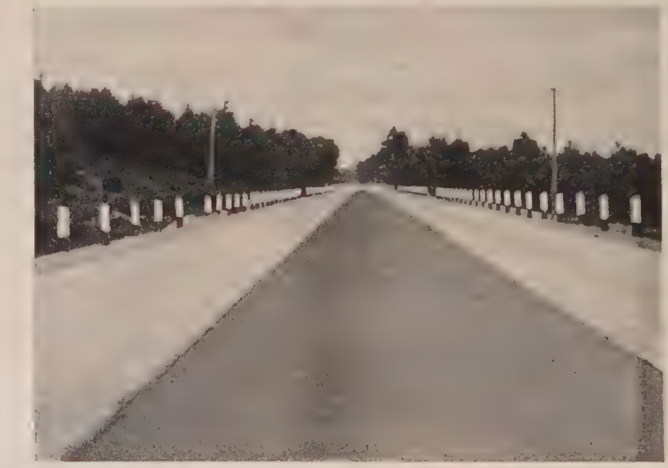
The idea of a dark colored central lane for arterial highways is not new. Some years ago many miles of three-lane roads were built with the outer lanes of concrete and the center lane of bituminous materials. They too, kept traffic in line; but in many instances the cost of maintenance of the flexible center lane was prohibitive, and the so-called "dual-type" paving lost favor.

Now that emulsified blacks are practical and easily available, it is both technically and economically feasible to construct a dark colored center lane that is both rigid and rugged—dark colored concrete. It is claimed for these colorants that, in quantities up to and including three pounds of the emulsion per sack of cement, there can be no impairment of strength, durability, or toughness of the concrete. A concentration of three pounds of emulsion per sack of cement produces a color equivalent to that of a newly laid sheet asphalt pavement—a color that is popular with home owners and with drivers making long auto runs.

Emulsified carbon black was used above the plane of reinforcing at Nashua, N. H.

The use of emulsified carbon black appears to be extremely simple. On the Nashua job the proper quantity was merely poured over the aggregates in the concrete mixer skip and dumped with them into the mixer. It mixed quickly and uniformly throughout the mix to produce an intense black color while wet. After curing, the concrete lightened somewhat to a deep rich gray.

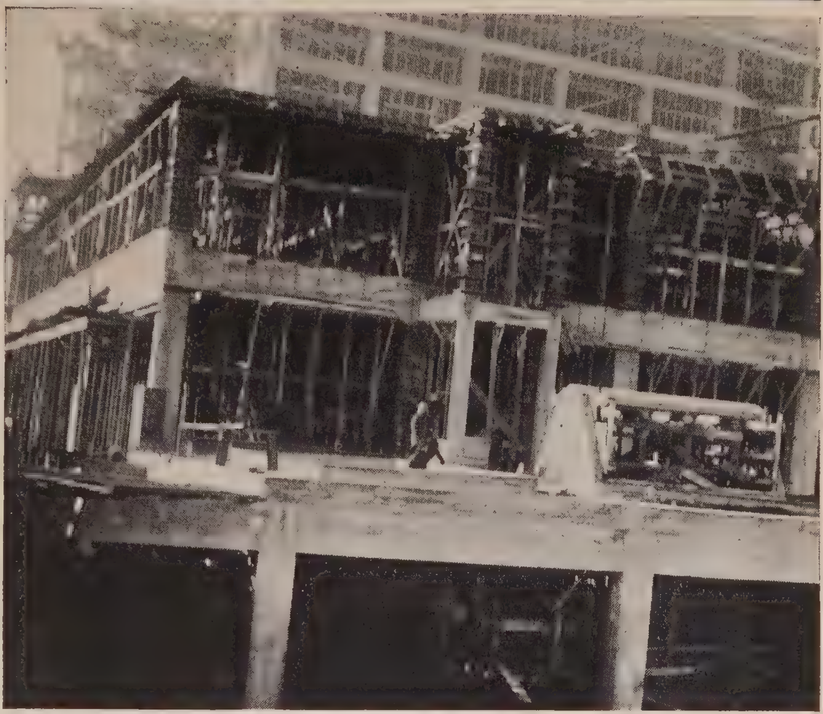
Dark colored concrete appears to offer a much wider usage of concrete paving. It affords the resident upon fine streets the quiet, dignified, restful appearance so essential to high realty values. It offers increased safety in that it accentuates white curbs and traffic markers. It absorbs the stains from oil droppings and from "road-oil" carried in from feeder roads and streets. It eliminates glare, makes driving pleasant to the eyes on the sunniest days.


Central lanes of dark colored concrete provide new attractiveness and safety

With the ever-widening acceptance of dark colored concrete it seems reasonable to assume that concrete paving will invade the market now held by other types, particularly in sections where there are traffic control factors involved. Again, concrete will now be welcome where there have hitherto been objections to its natural color.

The emulsified carbon black employed in the work here described is produced by Godfrey L. Cabot, Inc., of Boston, and Binney & Smith Co., of New York. The work received the close personal attention of D. H. Dickinson, chief engineer, and J. McCormick, engineer of materials, of the New Hampshire State Highway Department. W. H. Nelson was resident engineer for the state. The contractors were B. Perini & Sons, Inc., of Framingham, Mass.

PROFITS VERSUS PENALTIES



Today's keen competition in the concrete-construction field often leaves the successful bidder with little time-margin for bad weather or other contingencies. The consequence is that contract-stipulated penalties are constantly threatening and bonus chances are frequently slim.

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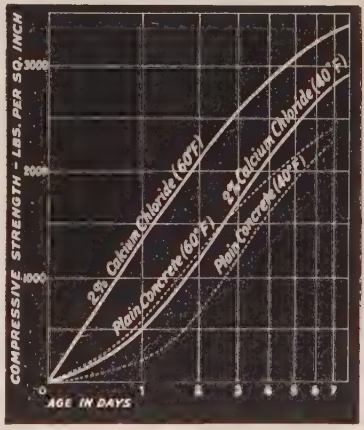

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Vibrated Concrete

I am a new subscriber to Concrete, *and am interested in particular in placing concrete under the influence of high-frequency vibration. Can you give me a list of references to articles in past issues of* Concrete *that deal with this subject?—M. F. L., Cleveland, Ohio.*

The following articles, printed in the issues of Concrete indicated, describe a wide range of use of high-frequency vibrators in the placing of concrete:

March, 1929, page 47—Effect of Vibration of Air Hammer on Concrete Placing (A. C. I. paper).

March, 1931, page 23—Vibrated Concrete Coating Protects Underground Pipe Lines.

February, 1932, page 7—Extent of Practice of Vibrating Concrete in 1931 (Struc. Review).

December, 1932, page 8—Vibrated Concrete One of A. C. I. Major Convention Topics.

January, 1933, page 17—Use High-Frequency Vibration in Casting Concrete Piles.

May, 1933, page 13—Place Concrete Under Water Through Vibrated Tremie Spout.

July, 1933, page 13—Vibrated Concrete in Production of Burial Vaults.

August, 1933, page 8—Vibration and Delayed Finishing Improve Pavement Concrete (A. S. T. M. paper).

September, 1933, page 2—Vibrators Compact Concrete Placed by Pumpcrete.

January, 1934, page 15—Many Uses for Vibrating Equipment in Cast Stone Plant, by Geo. B. Pickop.

February, 1934, page 12—How Concrete Vibrators Are Specified.

June, 1934, page 10—Ohio Tests Show Vibrated Concrete Makes Stronger Pavement.

Ready-Mixed Concrete Plant of Moderate Size

I am looking for information on the equipment and installation costs involved in the construction of a commercial ready-mixed concrete plant in a city of relatively small size, near Philadelphia. Can you refer me to such information?—B. A. G., Philadelphia, Penna.

If you will consult bound volumes of the magazine Concrete in your public library or at the office of private engineering concerns you will find a number of articles dealing with plant installations of moderate size for the production of ready-mixed concrete. Articles having the following titles, and printed in the issues of Concrete indicated, will be of particular interest:

(1) Twenty Ready-Mixed Concrete Plants Surveyed by Investigator, by E. F. McCready, August, 1931, pages 17-19.

(2) Ready-Mixed Concrete Plant for Small City (Ann Arbor, Michigan). July, 1930, page 27.

(3) Profitable Premixed Concrete Plant Has Complete Equipment (Waukesha, Wisconsin). December, 1931, page 7.

(4) Operating and Marketing Policies of Pioneer Ready-Mixed Plant, by L. M. Dean. February, 1932, page 17.

Late in 1931 the Chain Belt Company, of Milwaukee, Wisconsin, compiled the results of a thorough survey of the costs and prices at twenty different ready-mixed plants in twelve different states. The booklet is entitled "Costs and Prices of Ready-Mixed Concrete in 20 Plants." Possibly you can obtain a copy by writing this concern. You might also communicate with the National Ready-Mixed Concrete Association, 545 Munsey Building, Washington, D. C., and with the Philadelphia office of the Portland Cement Association.

Fineness of Cement and Rate of Hardening

What information do you have available on the relation between the fineness of portland cement and its rate of hardening? I am not looking for a great mass of test data, but for a general relation expressed in an understandable way.—E. J. E., Davenport, Ia.

To understand the fineness of portland cement, it is necessary to know the percentages of the total that fall within certain size limits. In this respect all brands of cement may differ; but a general average of present-day cements will be found in a tabulation on page 16 of the April (1931) issue of Concrete, in an article headed "How Concrete in Wacker Drive Attained Great Strength." For the convenience of recent subscribers, who may not have older issues of Concrete available, the tabulation is here repeated.

Approximate Size Distribution of Portland Cement

Size of Cement Particles, in Microns[1]	Per Cent of Total[2]	Color	Time Rrequired for Complete Hydration[3]
Minus 10	21	Pure white	Less than 24 hrs.
10 to 20	16	Nearly white	24 to 48 hrs.
20 to 30	8	Very light brown	4 days
30 to 43	30	Light brown	7 days
43 to 74	16	Brownish gray	28 days or longer
Plus 74	9	Gray	Indefinitely long

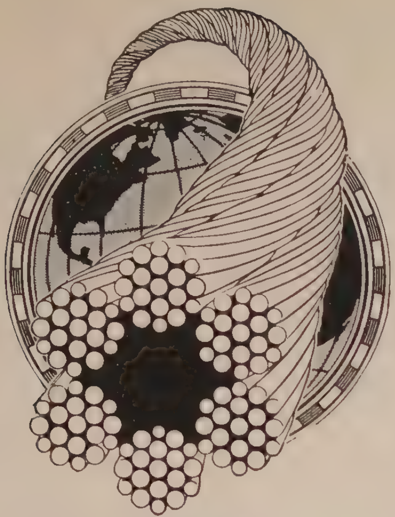
---

[1] Openings in the 200-mesh and 325-mesh screens correspond to 74 and 43 microns, respectively.

[2] Approximate percentages only, of an average portland cement.

[3] Approximate time only.

While this tabulation does not attempt to give the actual rate of hardening of this average cement, it may be assumed that a cement having *greater* than average percentages in the groups of smallest particle size will harden more rapidly than the average. Conversely, a cement having *lower* percentages in the finer sizes, and higher percentages in the coarser sizes, may be expected to harden more slowly than the average.



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(*Continued from page 14*)

ulations ranging from 11,000 to 33,000, have no concrete vault plants.

In Oklahoma there are only six plants, two of which are located in small cities. Seven other cities, with populations ranging from 15,000 to 32,000, have no plants.

The huge state of Texas has only 13 plants manufacturing concrete vaults, located in 11 cities; but that state has 18 cities having populations ranging from 20,000 to nearly 300,000, indicating that some good markets are untouched.

Kentucky has only six concrete vault plants, located in five cities. Four other cities, with populations ranging from 22,000 to 65,000, have no plants.

Many Markets Untouched

Further examination will show many other states in which similar conditions exist, with large, untouched markets available to the manufacturer who will develop them.

Mention has already been made of four states containing no plants manufacturing concrete burial vaults, and five states containing only one plant each.

The table shows, further, that 15 states contain from two to nine plants. In a word, 24 states contain less than ten plants each. In fact, these 24 states combined have a total of only 102 plants.

Selecting a Location

In looking for a profitable location, the prospective manufacturer of concrete burial vaults will, quite naturally, try to avoid too much pioneering. For this reason he will prefer a location where the public is already thoroughly "sold" on the concrete vault. The map shows where such locations may be found. Perhaps his second choice will be in localities where the concrete vault has been introduced, but where the market is not yet crowded. His last choice will be a locality where the concrete vault is not known.

The prospective manufacturer will also prefer a location where he has a reasonably large city population near at hand. This is especially important when he is going into a community where the concrete vault is unknown, because he will obtain quicker recognition in the city than in the surrounding country districts. Likewise, if he is locating in a section where the country people are in a backward state of development, he will have to depend almost entirely on the city population.

Above all, it is evident that many good locations lie open for development, and that there is no need to enter a market that is already occupied by a competent and responsible manufacturer.

Bids for Monolithic Concrete Lower Than for Brick

THE economy of monolithic concrete wall construction, as compared with walls of brick, recently was demonstrated in Portland, Oreg., when the U. S. Forestry Service opened bids for a new warehouse.

Alternate bids had been requested on monolithic concrete walls and on brick walls. The low bids were $66,629 for concrete and $69,900 for brick. The local forestry office recommended acceptance of the bid for monolithic concrete walls.

Coming Conventions

September 10-14—**American Chemical Society. 88th Annual. Cleveland, Ohio. Dr. Chas. L. Reese, President, 330 W. 42nd St., New York City.**

September 24-28—**American Society of Municipal Engineers. Annual Meeting. Rochester, N. Y.**

December 6-7—**Highway Research Board, National Research Council. Fourteenth Annual Meeting. Roy W. Crum, Director, 2100 Constitution Avenue, Washington, D. C.**

1935

February 19-21—**American Concrete Institute. Thirty-First Annual Convention. Roosevelt Hotel, New York City. Harvey Whipple, Secretary, 7400 Second Blvd., Detroit, Mich.**

Special Cements Improved by Addition of Puzzolana

Blend of 40 Per Cent of Puzzolanic Material Strengthens Resistance to Sea Water

A BRIEF item in *Building Science Abstracts* (London), Vol. 6, No. 11, mentions an article by F. Ferrari, in *L'Industria Italiana del Cemento*, in which the author tells of early attempts to provide a cement of high hydraulic value and capable of withstanding the attack of corrosive waters. Michaelis produced an iron-portland-puzzolana cement for use in marine structures, and another "Aegir" cement, practically free of alumina. In 1910, Ferrari prepared mortar specimens of mixtures of iron-portland and puzzolana, of cements of the "Aegir" type, and of mixtures of "Aegir" and puzzolana, and stored them in sea and sulphate waters.

These cements, although more resistant to attack than the ordinary portlands, do, however, suffer considerable deterioration with time. A continuous diminution of strength, said to be caused by the formation of Candlot's salt, is noticeable. With the mortars of the "Aegir" type there is a slow diminution of strength caused by the lixiviation of the lime set free during the hydration of the cement. In 1913 and again in 1919 the author carried out experiments on portlands with the ratio $Al_2O_3 : Fe_2O_3 = 0.639$.

This led to the production of a "super-cement" which was patented in various countries. Composition, moduli, setting times and strength are given. Mention is also made of two similar cements, (1) Velo cement, and (2) Kühl cement. Products similar to these cements were prepared and tests were carried out on specimens with and without Bacoli puzzolana in the proportion of 60 per cent cement (by weight) to 40 per cent puzzolana. All the specimens were cured in tap water for 28 days and then placed in a saturated aqueous solution of calcium sulphate and tested for compressive strength and permeability at 28 days, 6 months, 1, 2, 3, 6 and 9 years. The results are tabulated. The author concludes that both these cements of high alumina and iron contents are improved in every sense by the addition of puzzolana, and the latter to a greater extent than the former.

Neal J. Ross, Missouri Commissioner of Corporations, has resigned to accept a position with the Ready-Mix Concrete Company of Kansas City.

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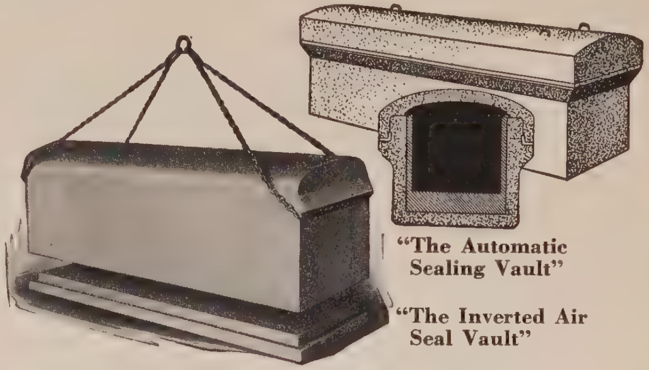

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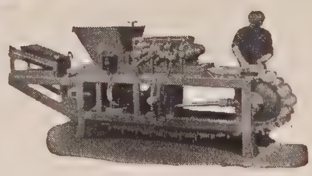

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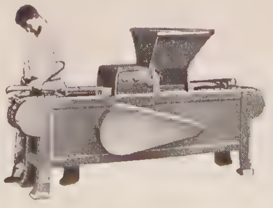

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The importance of variable mixes; tests for permeability; how to obtain strength, durability and watertightness; effective ratios; importance of proper construction methods—these and many other vital topics are discussed fully and authoritatively.

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A. S. T. M. President Passes

Dr. Herman von Schrenk, of St. Louis, Assumes Duties of President Temporarily

William Hastings Bassett, newly elected president of the American Society for Testing Materials, died at his home in Cheshire, Conn., on Saturday, July 21. Mr. Bassett, a pioneer metallurgist in the non-ferrous metal industry, and directly concerned with many of its technologic advances, was metallurgical manager of the American Brass Co., Waterbury.

Mr. Bassett's early and sustained work in the copper and brass industry probably did more than that of any others to place the industry on a scientific and technical basis. He introduced in this country the use of microscopy in the metallurgy of non-ferrous metals and was among the first to apply the spectroscope to routine work in the non-ferrous industry.

In 1925 he received the James Douglas Medal "for constructive research in copper and brass and other non-ferrous metals and their alloys and for his contributions to the establishment of the high standards of quality."

In June, after serving a two-year term as vice-president, he was elected president of the American Society for Testing Materials with which he had been affiliated since 1903.

As a personal member and the official representative of his company, he participated actively in the work of a number of A. S. T. M. committees. He took a leading part in the organization in 1909 of the first two A. S. T. M. standing committees in the non-ferrous field, B-1 on Copper Wire and B-2 on Non-Ferrous Metals and Alloys, and served continuously on these committees until his death. He served as a member of the Society's Executive Committee in 1916-1918. He always took a keen interest in advancing the knowledge of the properties of non-ferrous metals and supported actively a number of research and standardization projects in the Society.

During the World War, he was active on the Committee on Materials for Airplane Construction, in Washington.

He was a past-president of the American Institute of Mining and Metallurgical Engineers (1930) and a former director of the American Institute of Chemical Engineers. Other societies in which he held membership included American Chemical Society, American Society of Mechanical Engineers, Society of Automotive Engineers, American Electromechanical Society, Mining and Metallurgical Society of America, American Geographical Society, member of Franklin Institute, Institute of Metals of London, England, and of Society of Chemical Industry of London, England. His clubs included the Engineers' Club and Chemists' Club of New York and the Waterbury Club of Waterbury.

Mrs. Bassett and two children survive—Alice Whiting Bassett of Cheshire, Conn., and W. H. Bassett, Jr., technical superintendent and metallurgist, Anaconda Wire and Cable Co., Hastings-on-Hudson, N. Y.

No decision will be made concerning Mr. Bassett's successor as president of A. S. T. M. until the fall meeting of the Executive Committee. This committee is authorized to fill any vacancy occurring by death or otherwise in the officers' ranks. Dr. Herman von Schrenk, consulting timber engineer, St. Louis, Mo., as senior vice-president of the Society, will assume temporarily the duties of the presidency.

At Menominee, Wisconsin, the city will furnish the gravel, and the county will furnish the labor for the construction of curb and gutter if the lot owner will furnish the cement.

New Books and Pamphlets

Concrete Roads

DESIGN AND CONSTRUCTION OF CONCRETE ROADS. By R. A. B. Smith. Published by Concrete Publications, Ltd., London. Cloth, 260 pages, 120 illustrations, 12 tables. Available through Book Department of CONCRETE, 400 W. Madison St., Chicago, at $3.50 per copy, postpaid.

A thoroughly practical book by an experienced engineer, on concrete highway engineering practice in England. The scope of the work is shown by the subject-matter of individual chapters, including preparation of foundations, materials, design, reinforcement, joints, forms, proportioning and measuring concrete materials, placing and finishing concrete, curing (summer and winter weather conditions), organization, colored concrete roads, road junctions, curves and super-elevation, cost data, and maintenance costs.

One full chapter is devoted to cement-bound macadam, while another deals with footpaths and accessories. An appendix discusses the theory of stresses in slabs.

American and Canadian highway engineers will find valuable information in this book on British practice.

Low-Level Traffic Arteries for Buenos Aires

RED DE VIAS A BAJO NIVEL (System of Low-Level Highways) is the title of a 90-page, paper-bound printed report prepared by Pascual Palazzo, civil engineer, Buenos Aires, Argentina, describing and illustrating a system of low-level traffic arteries for Buenos Aires and suburbs.

In general, the system consists of a network of principal traffic arteries built at a low level, with cross streets carried over them at the natural grade. The desperate need for better traffic control in metropolitan areas is well illustrated by the author's statement that in 1922 one out of every 40 residents of the city was the victim of a serious traffic accident during his lifetime. Now the rate of accidents has increased so that one inhabitant out of every six is victimized.

Proceedings of Highway Research Board

PROCEEDINGS OF THE 13TH ANNUAL MEETING OF THE HIGHWAY RESEARCH BOARD, Part I, Papers and Reports of Research Committees. Paper bound, 410 pages, 7 by 10 in. Numerous diagrams and illustrations. Price not stated.

This volume, recently printed and dated 1934, contains the papers, reports and discussions presented at the annual meeting held in Washington on December 7 and 8, 1933. Because of the wide scope of subjects covered in the book, copies should be in the hands of all highway engineers. An author index and a table of contents serve as aids to the reader.

Inventions by Employees

THE RIGHTS OF EMPLOYERS IN THE INVENTIONS OF EMPLOYEES is the title of a 24-page pamphlet issued by Murray & Murray, patent attorneys, 53 W. Jackson Blvd., Chicago. Single copies are free, on request.

The booklet contains an outline of the law and practice relating to the rights of employers in the inventions of their employees, written in condensed form and without the use of technical legal terms.

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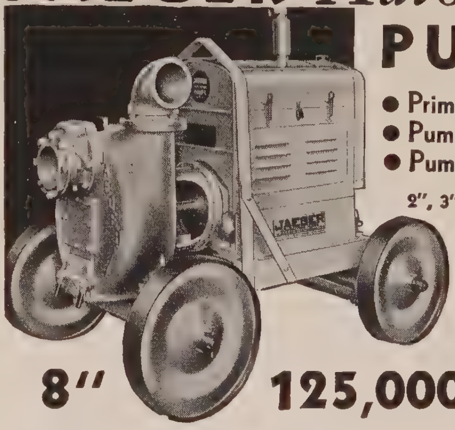

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EQUIPMENT AND MATERIALS

THE Robinson air activated conveyor has been added to its line of road building equipment by the Heltzel Steel Form & Iron Company of Warren, Ohio. This is said to be an inexpensive device for the economical conveying of pulverized or granular materials by air without a single moving or wearing part.

A complete system comprises a pressure tank, complete with cut-off gate and operator's panel; conveying pipe line leading to receiving bin with air filter; and an air compressor capable of delivering a small quantity of air at low pressure.

The pressure tank may be located either under or alongside of the railroad track.

This conveying system permits the erection of the receiving plant or bin at some convenient point and conveys economically over long distances, they say. It is used in unloading materials from trucks, cars and boats to storage silos and mixer bins in ready-mixed concrete and concrete products plants, enabling the advantage of saving incident to the use of bulk materials.

It is now in use on a large lock job, and also in connection with a central concrete mixing plant, the makers say.

●

SUPERBETON is the trade name for a machine with molds for the manufacture of concrete pipe—sewer pipe, water mains, irrigation pipe, piles or posts—by a centrifugal process and under the influence of high frequency vibration. V. Muzak of Bruxelles, Belgium, the maker of this machine, claims that by this process the spun concrete pipes may be taken from the molds immediately after the spinning, thereby giving the advantages of rapidity of manufacture and the saving of molds and space.

●

KLEARKOTE is a surface waterproofing, a product recently introduced by the Johnson-March Corporation of New York City, said by the makers to be a positive surface protection for concrete, concrete products and stucco.

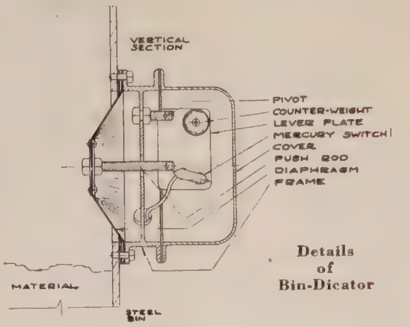
●

A NEW end discharge mixer—7S and 10S—is described and illustrated along with other Master models in a bulletin just published by the Construction Machinery Company of Waterloo, Iowa.

●

BIN-DICATOR is a bin level indicator, manufactured by the Ripley Manufacturing Company, Wayne, Michigan. This device is used to indicate the level of material in bins or hoppers, the over-feed or choking of screw conveyors and bucket elevators, and the automatic operation of feeders and conveyors in connection with filling bins or hoppers. It is applicable in the handling of cement, lime, gypsum, sand, gravel, coal or almost any type of pulverized or granular material.

One 8-in. diameter hole is required in the bin wall or screw conveyor cover. The Bin-Dicator is fastened over the hole with six bolts. The two leads from the mercury switch are then connected to the signal or control system. The operating mechanism consists of a dust-tight canvas diaphram which actuates a simple counterweighted lever, which in turn operates a mercury switch. When the material exerts a pressure at a point where the Bin-Dicator is mounted, the canvas diaphram moves outward and operates the mercury switch. When the pressure exerted by the material is relieved, the counterweight forces the diaphragm back to its normal position, reversing the operation of the switch.



Details of Bin-Dicator

Manufacturers' News

CERTIFIED Operators are recorded in a new department built by the Harnischfeger Corporation of Milwaukee both to assist owners of P & H equipment and in finding work for unemployed operators.

To become a P & H "Certified Operator," the first requirement is five years' actual experience in operating a P & H machine. In addition the operator must take and successfully pass with a grade of 80 per cent an examination covering practical operating questions, construction details, and servicing of the machine. His references as to ability, character, and personal habits are thoroughly investigated before his certificate is issued or any recommendations made to prospective employers.

A permanent record of "Certified Operators" is kept at the factory and branches.

●

CHAIN Belt Company of Milwaukee, Wisconsin, announces the appointment of the Jenison Machinery Company, 20th and Tennessee Streets, San Francisco, California, as a distributor of Rex construction equipment in the northern portion of the State of California. A stock of Rex mixers and pumps is carried.

Industrial Literature

TRAYLOR Engineering & Manufacturing Company, Allentown, Pa., has prepared a new circular entitled "Wheel 'er to the Job" describing their semi-portable crushing plant with illustrations and drawings of two such plants—a level site plant and a hillside plant, designed for up to 30 tons hourly capacity. The crushers used are standard stationary machines mounted on steel skids provided with means for attaching suitable wheels and axles for transportation from place to place. Either electric motor or oil engines may be used for power.

●

S. R. P. Coatings, manufactured by L. Sonneborn Sons, Inc., New York City, may be applied successfully over rusty surfaces without any previous preparation thereof, the makers say. They claim the coatings check further erosion and create over the rusty surface a film which prevents disintegration; that they have withstood exposure to sulphuric and hydrochloric acid, ammonium hydroxide, strong alkaline hydrogen sulphide and salt water. Test panels and samples are offered.

●

TURN Waste into Profit is the title of a 4-page folder issued by Skinner Motors, Inc., of Detroit, Michigan, illustrating their oil reclaimer. They recommend its use to the owners of five or more trucks and list among the users the Ohio and Rhode Island State Highway Departments.

●

REX speed prime pumps are described in a new folder being distributed by Chain Belt Company, Milwaukee, Wis. Tables are included to demonstrate the dewatering capacities of these pumps.

ORGANIZATIONS

American Association of State Highway Officials; W. C. Markham, Executive Secretary, 1222-24 National Press Building, Washington, D. C.

American Chemical Society, Mills Building, Washington, D. C.

American Concrete Institute; Harvey Whipple, Secretary, 7400 Second Blvd., Detroit, Mich.

American Concrete Pipe Association; M. W. Loving, Secretary, 33 West Grand Ave., Chicago.

American Institute of Chemical Engineers, Bellevue Court Bldg., Philadelphia, Pa.

American Railway Engineering Association; E. H. Fritch, Secretary, 59 East Van Buren St., Chicago, Ill.

American Road Builders' Association; Chas. Upham, Engineer-Director, National Press Building, Washington, D. C.

American Society of Civil Engineers; Geo. T. Seabury, Secretary, 33 West Thirty-Ninth St., New York City.

American Society for Testing Materials; C. L. Warwick, Secretary-Treasurer, 260 S. Broad St., Philadelphia, Pa.

Associated General Contractors of America; E. J. Harding, Managing Director, 222 Munsey Bldg., Washington, D. C.

Building Officials Conference of America; Wm. F. Hurd, Secretary, Room 203, City Hall, Indianapolis, Ind.

Cast Stone Institute; C. G. Walker, Asst. Secy., 33 West Grand Ave., Chicago, Ill.

Cement Institute; H. C. Lundborg, General Manager, 11 East 44th St., New York City.

Concrete Reinforcing Steel Institute; R. W. Johnson, Secretary, 333 North Michigan Ave., Chicago, Ill.

Engineering Institute of Canada; 2050 Mansfield St., Montreal, Quebec.

Highway Research Board; Roy W. Crum, Director, 2101 Constitution Ave., Washington, D. C.

Joint Committee on Standard Specifications for Concrete and Reinforced Concrete; F. R. McMillan, Secretary, 33 West Grand Ave., Chicago.

National Board of Fire Underwriters; W. E. Mallalieu, General Manager, 85 John St., New York City.

National Concrete Burial Vault Association; J. H. Stuart, Secretary-Treasurer, Bremen, Ohio.

National Concrete Masonry Association; Horace W. Bush, Secretary and Treasurer, 211 Edgemont Place, Teaneck, N. J.

National Crushed Stone Association; J. R. Boyd, Secretary, 1735 14th Street, N. W., Washington, D. C.

National Fire Protection Association; Franklin H. Wentworth, Managing Director, 60 Batterymarch St., Boston, Mass.

National Lime Association; Norman G. Hough, Secretary and Manager, 927 Fifteenth St., N. W., Washington, D. C.

National Ready-Mixed Concrete Association; V. P. Ahearn, Secretary, 545 Munsey Bldg., Washington, D. C.

National Sand and Gravel Association; V. P. Ahearn, Executive Secretary, 545 Munsey Bldg., Washington, D. C.

National Slag Association; H. J. Love, Secretary-Treasurer, Earle Building, Washington, D. C.

National Terrazzo and Mosaic Association; J. M. Fuhrman, Secretary-Treasurer, 524 Brook Street, Louisville, Ky.

New Jersey State Concrete Products Association; Horace W. Bush, President, Lyndhurst, N. J.

Portland Cement Association; Edward J. Mehren, President; William M. Kinney, General Manager, 33 West Grand Ave., Chicago.

Rail Steel Bar Association; H. P. Bigler, Engineering Secretary; Builders' Bldg., 228 N. La Salle St., Chicago, Ill.

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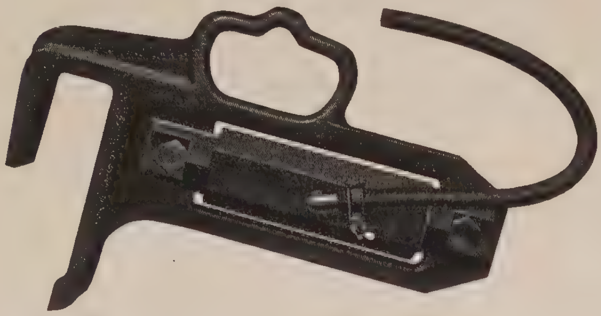

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No. 9

Cement Mill Section of
Concrete

SEPTEMBER
1934

Efficiency of Various Grinding Media for Tube Mills

Different Kinds, Sizes and Shapes of Grinding Bodies Compared—Writer Recommends Cylindrical Media Having Length Equal to Diameter

By OTTO SCHOTT
Consulting Engineer, Heidelberg, Germany

(Translated from the Spanish by A. W. King, Chicago, Illinois)

This interesting discussion of grinding media, written expressly for the Spanish periodical Cemento (*Barcelona*), *appeared originally in the July* (1934) *issue of that magazine.*—Editor.

In cement plants that use tube mills for grinding raw materials, clinker and coal, the cost of the grinding bodies (balls, or grinding charge) plays a very important part, and particularly so when it is a question of grinding clinker that is produced by rotary kilns.

The capacity and efficiency of a mill depend upon the hardness and the structure of the material to be ground, and also upon the form and the material of the grinding bodies, as well as the correct quantity relationship between the grinding bodies in each one of the compartments of the mill. Good ventilation of the interior also makes its influence felt on the capacity of the mill.

In most of the cement plants at the present time, there are being used mills having three compartments. In the first two compartments spherical grinding bodies are used, whereas in the third compartment, where fine grinding takes place, grinding bodies of various shapes, such as are commercially available, are used. Of all these, the most suitable are those shaped spherically, cylindrically or cubically.

Dimensions of Grinding Media

The dimensions of the grinding bodies depend, as is logical, upon the particle size of the material to be ground. In the first compartment, large (spherical) balls are used which commonly have a diameter varying from 60 to 100 mm., and which act in the manner of a hammer on an anvil.

In the second compartment, in which preliminary grinding occurs, it is commonly necessary to use grinding bodies having a diameter from 30 to 50 mm. The grinding charge contained in the third compartment (finishing compartment) should function solely by frictional work. The greater the total area of these bodies, the better will the fine grinding be done in this compartment.

In order that the material to be ground can be introduced, and can accomplish passage through the mill adequately, it is indispensable that sufficient space exists between the grinding bodies to allow this passage to take place. Each compartment, therefore, should be filled with a mixture of large and small grinding bodies.

Testing Strength and Hardness

The grinding bodies are made of steel forgings or chilled cast iron. In order to be able to judge the quality of the material used in making them, it is necessary to know their strength, hardness and toughness.

The strength, as is well known, is determined by rupturing a test-specimen; however, there are several methods used in determining the hardness. In most cases hardness is determined either by the Brinell or the Shore method. The former is obtained with a sphere under pressure, and the latter by measuring the hardness rebound of a little hammer tipped with a diamond point which is allowed to drop on the material to be tested.

A very simple manual method, and one that is practical for testing hardness, employs the "Sklerograph," which also is based on the principle of rebound. It is an inexpensive piece of apparatus which permits direct reading of the hardness index and which will be found to be very helpful to the superintendent of a cement plant.

There is a definite relationship between the Brinell hardness, the Shore hardness and the tensile strength. For the corresponding calculations there are suitable numerical tables.

Kinds and Types Compared

The Brinell hardness of the commonly used forged steel ball is 285 to 300 units, which corresponds to a tensile strength of 90 to 100 kilograms per square millimeter. By means of special processes there are obtained forged steel balls of great hardness, having a Brinell index in excess of 450 units. The grinding bodies made of chilled cast iron, "Rukiola," also possess extraordinary hardness, but in this case the advantages are offset by certain drawbacks: the outer hard layer is only 15 to 25 mm. thick, and after a certain time it is worn away. Besides, there is the drawback, which should always be taken into consideration, that a cast-iron ball might have blow-holes, which always constitutes danger that leads to breakage.

And finally, the cast-iron balls do not have the ease of movement possessed by the forged steel balls. This ease of movement is an important consideration in connection with the first compartment of the mill. It should be borne in mind that the spherical grinding bodies function in such a manner as to produce a "point-contact" grind. Between these balls there is sufficient space through which the raw materials can pass.

While balls made of good steel wear uniformly and have a free tension, the same can not be said of chilled cast-iron balls, because the hardened layer of these cast balls, as is to be expected, is the thinner the smaller the diameter, and consequently they wear down much more quickly.

Factors Influencing Resistance to Wear

Resistance to wear of a material depends not only on its hardness, but at the same time upon its tensile strength, its toughness and its metallic structure.

Cubes of forged steel which have rounded edges and corners, and which have an extraordinary Brinell hardness, can not be used alone; it is necessary to mix them with small steel balls. The price of these cubes is considerably higher than that of forged steel balls and of cylindrical grinding bodies.

With cylindrical grinding bodies, there is obtained a "line" type of grinding. The well-known grinding bodies called "Cylpebs," which have this form, are used in dimensions 13 mm. by 21 mm. to 30 mm. by 50 mm., having lengths greater than their diameters. The flow of raw material between them is very good because of the favorable distribution of space between the grinding bodies and the raw material. Their great drawback comes after an extended period of grinding, when, as a result of wear, they are transformed into square bars that obstruct the channels in the walls of the mill.

Most Efficient Shape

It has been demonstrated that the cylindrical grinding bodies having a length equal to their diameter are the best. They group themselves much more effectively than the Cylpebs, and they possess, moreover, a large grinding surface. Grinding bodies of various sizes should be mixed in order to obtain sufficient space for the passage of the raw material. When charged in sufficient quantity, they function well and with a high efficiency. They can be used until worn 95 per cent.

The danger presented by the well-known formation of platelets when short cylinders are used, is less than that presented by any other grinding body; and besides, their cost is less than that of steel balls and cubes.

In order to obtain an accurate idea of the wear of the grinding bodies, it is necessary that the test extend over a long period—one year, at least.

Experiments have shown that with the use of the ordinary forged steel balls having a tensile strength of approximately 100 kilograms per square millimeter, wear varies from 0.45 to 1.00 kilogram per ton of rotary-kiln clinker ground. Balls of steel having high resistance to wear and hardened by special processes have a wear of only 0.1 kilogram for the same quantity of clinker ground.

Repeated Tests Necessary

As we have already shown previously, the optimum determination of the space occupied by the grinding bodies in each one of the compartments of a mill exercises a very great influence on the efficiency of the mill. The total of this space in a tube mill should be, generally speaking, from 20 to 40 per cent of the section of the tubes.

It is very important that the total weight chosen for all of the grinding bodies be distributed properly in the various compartments; also that the grinding bodies be mixed in such sizes and appropriate form for the purpose of obtaining the highest possible efficiency. In order to secure the maximum efficiency, it is necessary to perform repeated tests and use graphical grinding charts.

Silicosis Measure Introduced in New York Legislature

Silicosis would be brought under the terms of the Workmen's Compensation Law by an amendment introduced in the New York State legislature. There is no known cure.

The bill was a Department of Labor measure, drafted after a series of conferences with insurance companies, employers, and labor, and represents a compromise in many respects.

In the past few months several hundred suits, asking for more than $1,000,000 in damages, have been filed in the state courts. Employers and insurance companies, faced with the threat of court awards of many thousands of dollars to employees suffering from silicosis, are now behind the move to make it a compensable disease.

Because of the special and difficult nature of silicosis and its symptoms, the bill provides for the appointment by the industrial commissioner of three physicians with special experience and qualifications in diagnosing to examine all persons claiming compensation.

Silicosis increases susceptibility to other diseases, notably tuberculosis, and when complicated with them it is difficult to identify, except by specialists. It results from breathing the silica dust or silicon oxide. There is no known way to clear it up and restore normal lung tissue.

Mining Limestone by Caving Method

WORKING of the Riverside Portland Cement Company's limestone deposit at Crestmore, Calif., is described by C. A. Robotham in a 20-page multigraph designated as Information Circular 6795 and published by the Section of Publications, U. S. Bureau of Mines, Washington, D. C. Copies may be obtained without charge, by addressing the Section of Publications.

In these operations the caving method is employed—based on the technique developed in the mining of copper ore in the Ray and Globe-Miami districts in Arizona.

Nature of Portland Cement Clinker

How Polarizing Microscope Is Employed in Identification of Compounds of Clinker—Obtaining X-Ray Diffraction Pattern

By H. G. FISK
Petrographer, Buffington Plant, Universal Atlas Cement Co., Buffington, Indiana

The first Section of this paper, printed in last month's issue, covered the chemistry of portland cement clinker formation from the standpoint of equilibrium diagrams. The present (and final) installment, comprising Section II, describes the use of the polarizing microscope and the X-ray in the identification of the compounds in portland cement clinker, and the limitations of these lines of investigation.

As stated in the previous issue, this paper is presented to our readers through the courtesy of the author and the editor of the Journal of Chemical Education, in which it originally appeared.—Editor.

SECTION II

Petrographic and X-Ray Methods as Applied to Portland Cement

Up to about fifteen or twenty years ago, cement manufacture was an art rather than an industry based upon scientific control, and it was found largely by trial that certain raw materials and rather definite proportions of these lent themselves to the manufacture of portland cement clinker of desirable properties. Gradually it was realized that the processes involved and the resulting products are subject to the laws of physics and chemistry. It was discovered that as the raw materials are heated during clinkering, new compounds are formed and that these compounds as previously mentioned have distinctive physical and chemical properties.

For many years knowledge of the nature of the products formed during the clinker process in cement manufacture was based entirely upon chemical analysis. Chemical analysis shows what oxides are present, and the amount of each, but does not show how the oxides in a heterogeneous mixture are combined. Today we believe that the properties of a mixture of substances which has been subjected to chemical processes are due to the resulting compounds, and are not simply the properties of the constitutent oxides or substances.

Polarizing Microscope Is Valuable Aid

Between 1880 and 1900, Le Chatelier in France and Tornebohm in Sweden, independently of each other, introduced as a new tool into the field of cement study, the petrographic microscope. The use of this instrument has been of the greatest importance, as it has enabled the positive identification of the individual minerals in clinker, by the precise measurement of their optical constants; and has thus led to investigation and knowledge of their individual chemical and physical properties, as well as an understanding of the constitution of clinker.

Le Chatelier and Tornebohm, followed by others, found that well-burned clinker consists of crystalline minerals. They agreed that certain minerals are generally present, and gave them different names, but were not agreed on the chemical nature of the individual minerals. Due to the fact that the minerals generally form or grow in exceedingly small grains or crystals, usually not visible to the naked eye, it has not been practical to separate them from each other and thus study their individual chemical and physical properties. For this and other reasons, a long controversy as to the character and properties of these minerals followed; and it remained for the Geophysical Laboratory of the Carnegie Institution at Washington, and the Portland Cement Association Fellowship at the Bureau of Standards in Washington, to clear up this problem. By a microscopic and "phase rule" investigation of the three-component system, lime-alumina-silica, the scientists at the Geophysical Laboratory found that the chief minerals present in portland cement clinker are tricalcium silicate, dicalcium silicate, and tricalcium aluminate. Their studies did not include iron oxide, which is always present in grey cement. However, the recent work already referred to has shown, by methods similar to those used at the Geophysical Laboratory, that iron oxide enters a compound represented by the type formula, $4CaO.Al_2O_3.Fe_2O_3$. It has thus been established that four major minerals form in portland cement clinker. Experimentation with these minerals prepared synthetically has explained the functions of these different compounds in cement. It has thus been found that tricalcium silicate, and to a lesser extent the high-temperature form of dicalcium silicate, are responsible for the strength of portland cement, and that the aluminates cause the initial set which it is necessary to govern by the addition of sulfates (usually gypsum) to the ground clinker. Just as natural minerals vary somewhat in composition, and as a result of these variations the physical properties vary, we find slight variations of the optical properties of minerals in clinker.

Synthetic Minerals in Cement Clinker

In the strictest sense a mineral is a homogeneous substance found in nature, which has definite physical properties and a characteristic composition. Many of the minerals found in nature can be produced synthetically in the laboratory or in industrial processes. Minerals thus produced are called synthetic or artificial minerals. Some artificial minerals are not found in nature. The minerals formed in cement clinker are synthetic minerals. A chemical formula represents definite proportions or amounts of the oxides, elements or compounds it involves. For the reason that minerals are not always of exact definite composition, a formula may not always represent the true composition of a mineral, although minerals may be considered to have type formulas. The tendency of minerals to vary in composition is explained by "solid solution"—meaning the replacement of an element or compound, to a greater or less extent, by another of similar chemical or physical properties without destroying the homogeneity of the mineral.

It is frequently asked how it is possible for crystals to form in a mass which is heated below the point of complete melting. It is now well known that many substances can react in the solid state, particularly at high temperatures, to form new compounds. It is also known that certain substances, which together with the others, form a low-melting liquid and are known as fluxes, promote the reactions. In the clinkering process, the aim is to form a large amount of tricalcium silicate by a reaction between lime and silica. As a matter of fact, the lime and silica probably first react at relatively low temperatures to form dicalcium silicate and later at higher temperatures the dicalcium silicate reacts with more lime to form tricalcium silicate. It is this latter reaction which is the most difficult one to effect, and it is chiefly to promote this one that the fluxes are necessary. Later, as the mass cools after leaving the hottest zone of the kiln, the part which was liquid or pasty in the kiln solidifies and the resulting mass is chiefly or entirely crystalline.

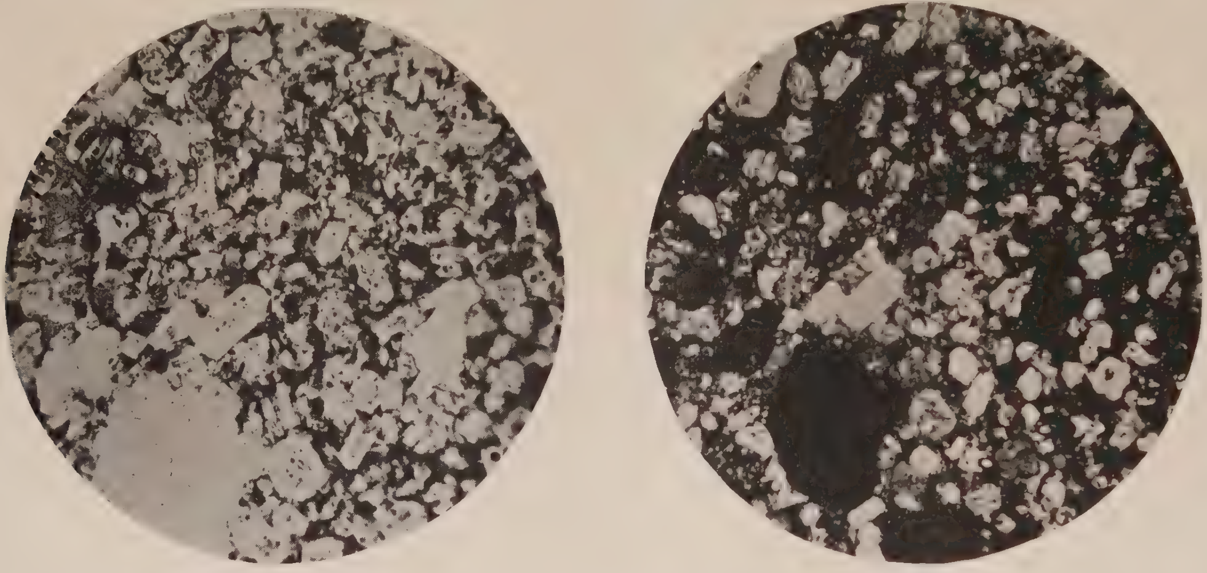

Figure 3. Left—Thin section of a fragment of portland cement clinker in ordinary light. The large transparent grains which often have straight edges and parallel sides are tricalcium silicate. The rounded grains which are frequently colored or turbid are dicalcium silicate. Dark patches without regular shape or outline are the iron oxide compound. Figure 4. Right—Same as Figure 3, except that polarized light was used instead of ordinary light. A large black void in the section is seen near the outside edge of the lower left-hand quadrant

How Polarizing Microscope Operates

The petrographic or polarizing microscope differs from the ordinary or compound microscope, in that it not only magnifies but also produces polarized light. By means of the effect of polarized light on crystalline substances, enabling the measurement of their optical constants and other characteristics which can be observed under the microscope, it is possible to identify the various minerals present in a crystalline mass.

As pointed out, the petrographic microscope made possible the identification, with certainty, of the minerals formed in clinker. In addition to enabling the detection of the individual minerals in a sample of burned clinker, it is possible by means of the microscope to make a fair approximation of the relative proportions of the various minerals, under favorable conditions, and thus observe how complete the burning process has been. Figures 3 and 4 show photomicrographs of a small part of a thin section of well-burned portland cement clinker.

Free lime (uncombined calcium oxide) can be identified by means of the microscope, and a large amount of it in burned clinker indicates one of two things—either that the raw mix was too high in lime to start with, or that the reaction of lime and silica was not completed, which may have been due to improper mixing or grinding of the raw materials, or insufficient heat treatment in the kilns.

Tricalcium Silicate

According to Rankin and Wright[4] the refractive indices of tricalcium silicate are close to 1.715. The mineral has low double refraction and is uniaxial or slightly biaxial-negative.* The optical data of Wright were determined upon the pure synthetic compound. In portland cement clinker the refractive indices of this mineral are generally found to be measurably higher than those of the pure compound, with the minimum index about 1.721 or greater. This is indicative of a slight but significant variation in chemical composition. Andersen and Lee[5] report that in basic open-hearth slags this mineral is frequently colored green and also has refractive indices higher than the pure compound—further evidence of solid solution.

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* The recent work of Anderson and Lee[5] on tricalcium silicate crystals extracted from basic open-hearth slags has shown that the crystals belong to the trigonal system and have a rhombohedral development.

Dicalcium Silicate

Probably the next most abundant constitutent to tricalcium silicate in grey portland cement clinkers is dicalcium silicate. In some white cement clinkers this mineral may, however, form the most abundant constituent. Although dicalcium silicate (β form) has hydraulic properties, its cementing value at early periods has been shown by different investigators to be low.

The high-temperature form of dicalcium silicate has an average refractive index quite close to that of tricalcium silicate, but in cement clinkers differs from it in being distinctly biaxial and positive. Its most characteristic diagnostic property, especially in thin section, is its higher birefringence. Its mode of development in clinkers is also distinctive, the crystals always lacking prismatic development and generally forming bunch-like groups of rounded grains. Polysynthetic twinning is sometimes observed, and when present is of diagnostic value. At times dicalcium silicate is green in color or a turbid brown.

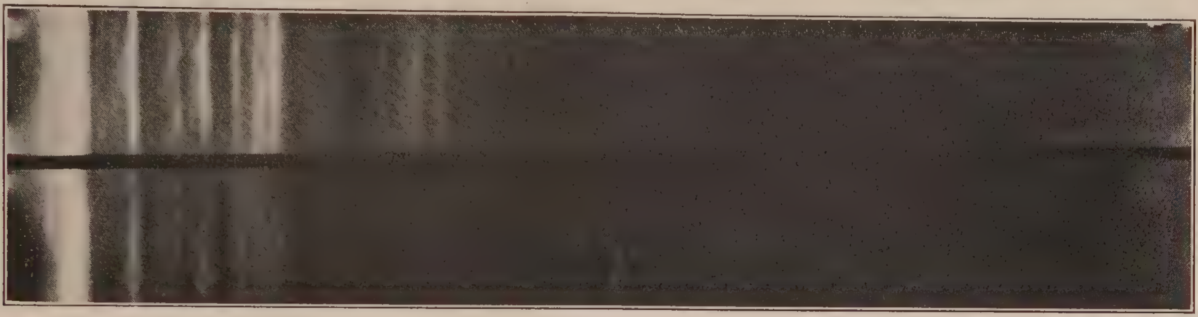

Figure 5. X-ray diffraction pattern, from photograph of diffraction spectrum

The low-temperature or gamma form of dicalcium silicate is not usually found in fresh well-burned clinker. When it is present in dusted, or old clinker, its refractive indices and appearance are means of detection.

Tricalcium Aluminate

Tricalcium aluminate is reported to crystallize in the isometric system. Rankin and Wright give 1.710 as the refractive index for the pure compound, which index is very close to that of tricalcium silicate and makes differentiation by means of the microscope difficult. As a matter of fact, this compound is not usually observed by means of the microscope in clinker. Recourse to the use of X-rays[6] must be taken to show its presence.

Tetracalcium-Alumino Ferrite

Phase studies[7] have shown that tetracalcium alumino ferrite forms a complete series of solid solutions with dicalcium ferrite. Guttmann and Gille[8] showed that manganese oxide can replace part of the iron oxide in this compound. Tetracalcium-alumino ferrite is readily detected by means of the microscope; its high refractive index, brown color, and pleochroism are distinctive. This compound forms an interstitial mass between the crystals of the silicates and may be mistaken for a dark glass, due to its lack of crystal outline and its dark color.

Lime

Small amounts of lime crystals are observed in most fresh clinkers. Their chief characteristics are isotropism, cubic cleavage, high refractive index, and their rounded form.

It is evident that the microscope is and has been a very useful tool in cement research, and also has an everyday application in the manufacture of portland cement clinker. However, the microscope has limitations, and one of these is that it is not possible to magnify particles which are below a certain size so that they become visible. Another limitation is that some substances are opaque or practically so, and do not transmit light even when finely powdered; thus, they do not permit the usual microscopic determinations depending on the transmission of light.

To furnish an insight into materials which do not lend themselves to study with the petrographic microscope, the methods of X-ray crystal analysis are rapidly coming into use.

X-Ray Diffraction Patterns

Present X-ray methods are based upon the fact that when a powdered crystalline material is subjected to X-radiations and the resulting diffraction spectrum photographed, an X-ray diffraction pattern is obtained, which consists of a series of lines in definite positions. Each crystalline chemical compound, when X-rayed in this manner, has a characteristic diffraction pattern which always appears the same with respect to the order and relative intensity of the lines, whether the compound is present in a pure state or intermixed with other compounds. Glasses and amorphous substances do not yield diffraction patterns similar to those of crystals. This is because the diffraction pattern depends upon the arrangement of the atoms of the substance in parallel planes. The difference between the crystalline state and the amorphous or glassy condition is that the atoms in the former are regularly marshaled, whereas the atoms or molecules of the latter are not arranged in definite order.

Figure 5 shows a print of a film obtained when a sample of portland cement was X-rayed by the powder method. It will be observed that the patterns are divided by a horizontal black line across the film. This is caused by a partition which divides the patterns from the two sides of the sample tube, or other holder. By placing different substances in the different halves of the sample tube, it is possible to obtain a pattern from one on one side of the film, and a pattern from the other on the other side of the film. In this way it is possible to compare directly on the same film the patterns from an unknown sample with that of a known one. In cases where the positions of the lines are to be measured it is necessary to employ a standard material, the positions of whose lines are known, in order to obtain fixed reference lines.

As the sample X-rayed by the powder method contains an infinite number of fine particles, some of which are oriented in every conceivable position, the lines obtained on a film represent reflections from all possible crystal faces. By the application of mathematical calculations, it is possible, when sufficient data have been obtained, to calculate the distance between the layers of atoms of the crystal. These distances are exceedingly small, and as ordinary units are far too large, a unit called an Angström unit, A.U., is used. An A.U. $= 10^{-8}$ or one-one-hundred-millionth of a centimeter.

In a paper on "The X-ray Method Applied to a Study of the Constitution of Portland Cement," by Brownmiller and Bogue[6], results obtained by an X-ray study of portland cements and of the mineral constitutents are given. In the summary the authors state, "The results obtained in this investigation by X-ray methods are in agreement with those obtained by phase equilibria, chemical and microscopical methods. Each supplements and confirms the other. Taken together the cogency of the findings becomes convincing. These findings define the constitution of portland cement clinker. They indicate that the most abundant constituents are tricalcium silicate and beta dicalcium silicate; that there are normally present, in addition, tricalcium aluminate, tetracalcium-alumino ferrite, and magnesia; and that free CaO is not normally present in amounts as great as 2.5 per cent."

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[3] Findlay, A., "The phase rule and its applications." Longmans, Green & Co., New York City, 1923, p. 192.

[4] Rankin and Wright, *Am. J. Sci.*, [4], 39, 1 (1915).

[5] Andersen and Lee, "Properties of tricalcium silicate from basic open-hearth steel slags," *J. Wash. Acad. Sci.*, 23, 338-51 (1933).

[6] Brownmiller, L. T. and Bogue, R. H., *Am. J. Sci.*, [5], 20, 241-64 (1930).

[7] Hansen, W. C., Brownmiller, L. T., and Bogue, R. H., *J. Am. Chem. Soc.*, 50, 396 (1928).

[8] Guttmann and Gille, *Zement*, 18, 500-6, 537-41, 570-4 (1929).

New Books and Pamphlets

Mechanical Power Transmission

MECHANICAL POWER TRANSMISSION FROM MOTOR DRIVE TO INDUSTRY., by Robert W. Drake. Published by American Leather Belting Association, New York City. Heavy paper cover, 226 pages, 8½ by 11 in. Numerous line diagrams and illustrations.

This comprehensive volume contains fifty reports covering all phases of the transmission of mechanical power from the electric motor to the driven machine, by belting and by other means. The problem is considered from the standpoints of design, maintenance, elimination of trouble, comparative production, and comparative costs, under a wide range of conditions and applications.

High-Temperature Insulation

HIGH-TEMPERATURE INSULATION is the title of a 30-page 6 by 9-in. pamphlet prepared and published by the engineering department of Johns-Manville Corp., New York. Copies are available on request.

The booklet contains a short review of the principles of heat transfer; a discussion of the theory and practice of conductivity values of insulation and refractories; insulation in boilers, kilns and other industrial equipment operated at high temperatures.

Qualifications of Welders

THE TESTING AND QUALIFICATION OF WELDERS is the title of a 24-page, 6 by 9-in. pamphlet issued by the Linde Air Products Co., New York.

The booklet outlines simple tests for measuring the ability of welders, these tests including the fracture test, the bend test, the tensile test, and others.

E. S. Guth, for many years district plant manager of the North American Cement Corp., has recently been appointed general plant manager of this company. Mr. Guth will have general supervision of all plants of the North American Cement Corp. He will continue his headquarters at Hagerstown, Maryland.

American Chemical Society Meets

MORE than 2,000 chemists and representatives of allied fields of science and industry will participate in the eighty-eighth meeting of the American Chemical Society to be held in Cleveland, September 10-14, according to the president of the Society, Dr. Charles L. Reese of Wilmington, Del. "Chemistry catalyzes commerce," will be the keynote of the assembly.

Progress in practically every field of chemistry will be reported in papers, addresses, and reports to be presented before the Society's professional divisions. Leading industries, universities and technical schools, state and government services, and private laboratories will send delegates.

The Division of Gas and Fuel Chemistry, headed by Dr. Harold J. Rose of the Mellon Institute, Pittsburgh, is planning the largest program in years, Cleveland being the center of leading research laboratories engaged in this field. A symposium on the "Properties of Coal" is scheduled.

On Friday, September 14, the chemists will visit Akron in a body to inspect the rubber and other industries under the direction of the Akron Section of the Society, of which G. K. Hinshaw is chairman.

Chelsea Plant to Be Dismantled

THE State-owned Chelsea cement plant, "white-elephant" of the Michigan state government for many years, is to be dismantled and salvaged by the State Prison Commission. An offer of $20,000 for the remaining clinker has been received. B. J. Abbott, secretary of the board, estimated other salvage would return $59,000 if the State wrecked the plant. This figure was based on the plant for scrap and included the railroad motors, fence, half million cement sacks, etc., and makes no computation for the 30 buildings, or the 800 acres of land which comprises the site. The best bid received for the plant was $41,000 for all property, buildings, clinker, etc.

The institution represents an investment of more than $1,000,000.

EDITORIAL

Advance Planning of Modernization

THE older cement manufacturing plants in this country grew from small beginnings, through various additions and improvements, to their present size. Often the work of reconstruction or addition was handicapped because of the difficulty involved in connecting up with older parts. Thus the plants grew up in haphazard fashion until a complete reconstruction became an urgent necessity.

The newer plants, however, were built in accordance with complete plans that made ample provision for future expansion.

Now we see plants being re-equipped and modernized in much the same way—that is, some have been completely reconstructed, while in others the work is being done piecemeal and without following a definite plan.

Usually the modernization efforts conducted in this piecemeal fashion are wholly inadequate to accomplish their main purpose—that of reducing manufacturing costs—because their effect is not sufficiently far-reaching.

Nevertheless, it is possible to modernize a plant piecemeal if each of the changes and new installations are made part of a comprehensive plan. Only because of the absence of a plan is the work ineffective; and the absence of a comprehensive plan may be due to any one of several causes—lack of time on the part of the plant management, or lack of funds to engage outside talent.

It may be accepted as a foregone conclusion that the plant management seldom will find the time necessary to make a complete survey of modernization requirements and to develop a complete plan which takes those requirements into account. Too many interrruptions, too many other hard problems to handle, leave the modernization plans hanging in midair. Then, when a new installation at some point becomes a definite necessity, it is slapped in without regard to future improvements.

There is little doubt that the engagement of outside talent is the only sure method through which a thorough-going modernization plan can be completed and put down on paper and blueprints. The funds for such an undertaking may be hard to find, but the expenditure will be the best form of investment.

Avoiding Handicaps in Burning Operations

THE most perfectly-designed rotary kiln will not perform efficiently if it is operated improperly. This is axiomatic. But if the kiln is not supplied with modern accessories that serve as aids in maintaining control, the burner can not be expected to obtain uniform quality.

To cite one example, it is of great importance that the kiln feed is synchronized with the speed of the kiln. This may be accomplished by having the drive of the kiln feeder synchronized with the kiln—a condition often realized through some electrical driving system in which the kiln motor and the motor driving the feeder are interconnected in such a way that a variation in the speed of the former causes a similar variation in the speed of the latter.

Another necessary requirement is accuracy in the control of combustion. The appearance of the smoke leaving the chimney is not always a reliable indicator of the completeness of combustion. In fact, when gas is used as the kiln fuel, the smoke from the chimney offers no indication whatever of incomplete combustion.

In some kiln installations much heat is wasted because of incomplete combustion, while in other cases heat is wasted because too large an excess of air is maintained in the kiln. The former condition is by far the most harmful, so that successful operation demands the maintenance of a slight excess of air.

Electrically-operated dampers designed to vary and regulate the chimney draft will enable the burner to control the draft easily and quickly. Draft indicators, likewise, are needed to show the draft at the kiln outlet and in the dust chamber at the kiln inlet.

Still another important accessory for controlling kiln operation is the pyrometer, which indicates and records the temperature of the gases as they leave the kiln. And gas analyzers, of course, constitute much-needed equipment.

To be sure, these accessories serve primarily as aids to the burner. Even with these devices installed, he must still be capable and conscientious; but without them the most capable operator works under a serious handicap—a handicap which a wise management will not place in his way.

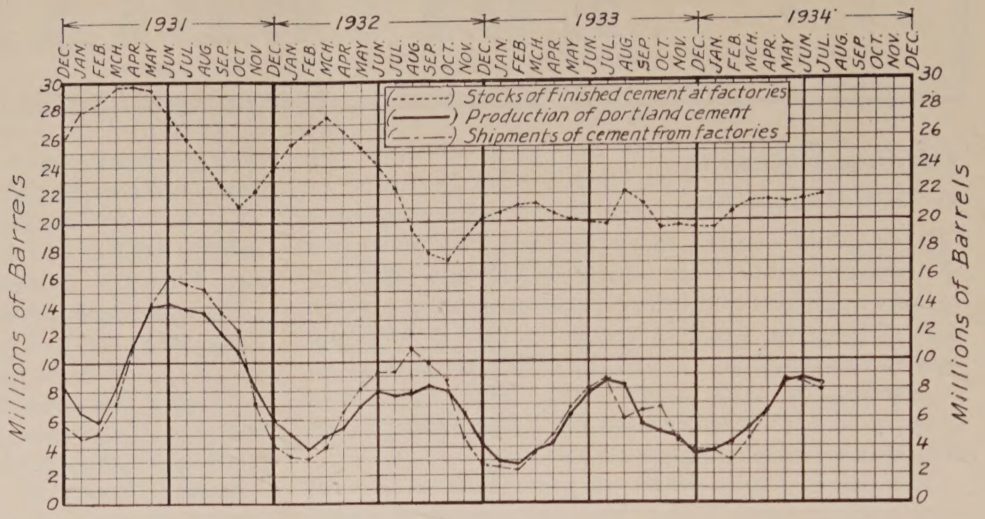
The Shape of Grinding Media

NOT all operating men will agree with the conclusions of Dr. Otto Schott, in the leading article in this issue, concerning the most efficient shape for grinding media for tube mills.

After pointing out that the grinding media's ability to resist wear depends not only on its hardness, but also on its toughness, its tensile strength and its metallic structure, he turns to the question of shape. On this point he favors cylindrical media having a length equal to their diameter.

Readers are invited to discuss this question of shape, for possible publication in future issues.

Cement Statistics for July



PRODUCTION of portland cement in July, 1934, showed a decrease of 5.5 per cent and shipments a decrease of 9.2 per cent, as compared with July, 1933. Portland cement stocks at mills were 10.0 per cent higher than a year ago.

Relation of Production to Capacity (Per Cent)

	The Month	Twelve Months
July, 1934	35.7	26.9
July, 1933	37.6	26.3
June, 1934	39.8	27.1
May, 1934	37.5	26.7
April, 1934	29.6	25.9

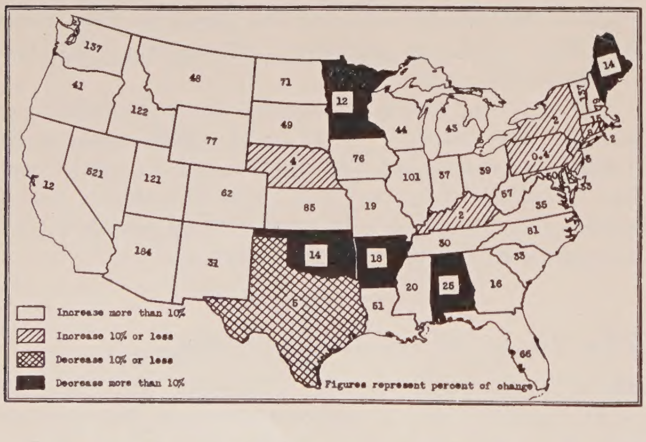
Production, Shipments and Stocks of Finished Portland Cement (Barrels)

	1933	1934
Production, July	8,609,000	8,134,000
Shipments, July	8,697,000	7,893,000
Stocks at end of month	19,848,000	21,842,000
Production for year to date	36,277,000	45,222,000
Shipments for year to date	36,624,000	43,056,000

In this stataement of relation of production to capacity the total output of finished cement is compared with the estimated capacity of 163 plants at the close of July, 1934, and of 164 plants at the close of July, 1933.

Cement Shipments Increase in 41 States

IN the 6-month period ending June 30, according to figures compiled by the U. S. Bureau of Mines, cement shipments in 41 states exceeded shipments during the corresponding period of 1933. The increases, recorded by states, ranged from 2 to 521 per cent.



Seven states reported decreases, ranging from 5 to 25 per cent. The tabulation here given shows a comparison with previous 6-month periods.

Period considered	Number of states Showing decrease	Showing increase
6 months ending Jan. 31, 1934	34	14
6 months ending March 31, 1934	17	31
6 months ending May 31, 1934	8	40
6 months ending June 30, 1934	7	41

From the Patent Office

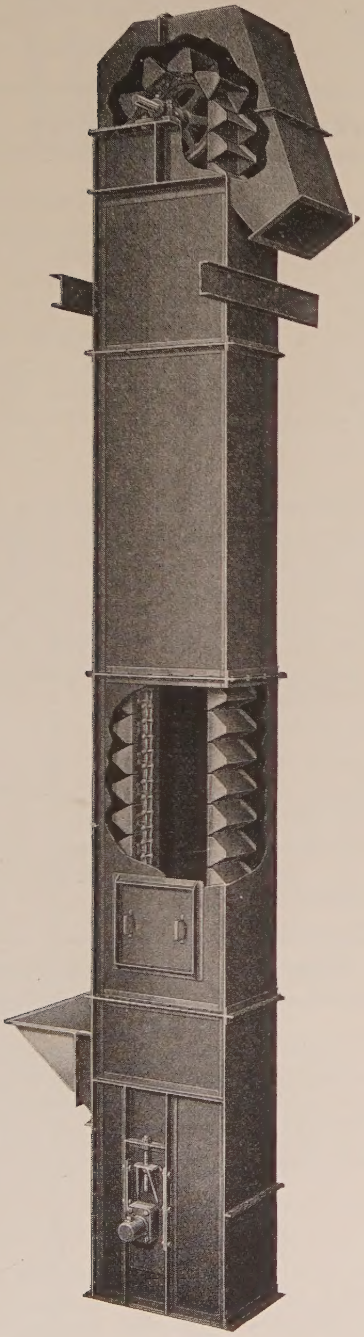
Cementitious materials: Alton J. Blank, Pueblo, Mexico. U. S. Pat. 1,953,924.—The process of producing a cementitious product consists of mixing a calcareous material containing lime in a form reactive to silica and alumina with a material selected from the group consisting of silica sands, siliceous earths and clays, and other argillaceous and argillo-calcareous materials generally known to be suitable as the raw materials for supplying the siliceous and aluminous components in portland cement manufacture, and previously reduced to a fineness of approximately 90 per cent through a 200-mesh screen or finer, said mixing being carried on in the presence of an amount of water sufficient to insure hydration of any quick lime present and sufficient to insure the presence of free moisture in the mixture throughout the mixing operation, and in the presence of an accelerating agent, and while mixing maintaining the mixture at a temperature of at least about 100 deg. C., and not exceeding about 400 deg. C., to produce mutual reaction between the lime and the siliceous components of said material.

●

Preheating raw cement material: David J. Uhle and Max W. Grunewald, Coplay, Pa. U. S. Pat. 1,961,311.—The method of preheating powdered solid cement raw material or the like and feeding the same to a rotary kiln consists of feeding such material at a relatively low temperature into one end of an elongated tube and providing a seal at such end, and passing the heated gases from the rotary kiln exteriorly of and in contact with the elongated tube to thereby heat the material in the tube to a relatively high temperature and convert the material into a form having the characteristics of a liquid whereby the air contained therein is expanded and aids in forcing the material from the tube into the kiln.

●

Portland cement manufacture: Martin Newcomer, Woodbridge, N. J., and Kay Newcomer, Independence, Mo. U. S. Pat. 1,959,796.—This invention comprises a method of breaking down a ring of sintered material on the wall of a rotary cement kiln while the same is in a highly heated condition which consists in introducing an explosive charge within the substance of the ring and exploding the same by the heat of the ring.



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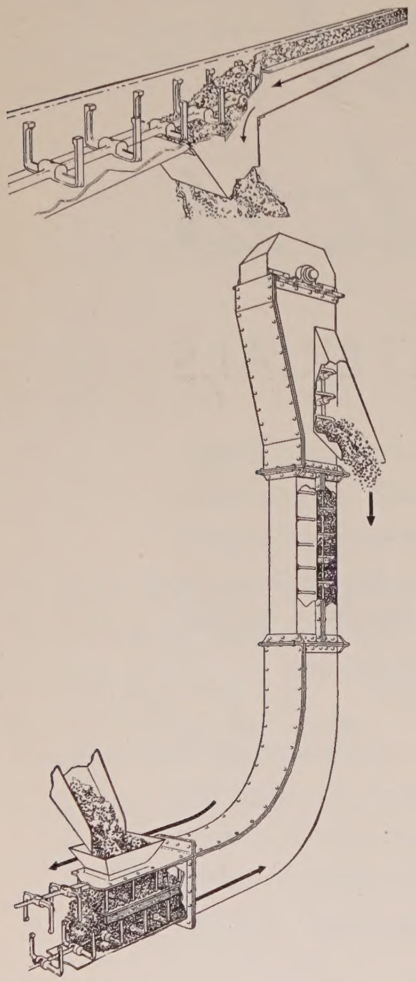
4930-E

MILL EQUIPMENT

REDLER continuous flow conveyors is the title of a new 16-page catalog just published by Stephens-Adamson Mfg. Co., of Aurora, Ill., describing their Redlar conveyor-elevator—a new and unique method of conveying bulk materials horizontally, vertically, up inclines and even around curves.



As shown in the illustration, the Redler conveyor consists of an enclosed steel trough, through which is pulled a light skeleton conveying element that causes the material to flow in a solid, tranquil column wherever the trough leads. The conveyor will feed itself a full load from bins or hoppers and can be discharged at any point by opening slide gates in the casing and allowing the material to fall gently away from the conveying element, they say.

This new catalog gives details, sizes, capacities and shows these conveyor-elevators handling coal, grains, malt, flour, starch, salt and even face powder.

●

G 25 is a new controlled insulating fire brick just announced by the A. P. Green Fire Brick Company, Mexico, Mo. They claim this brick is scientifically controlled at every stage of production, that it is light weight, highly radiant, has low conductivity, stops heat losses, cuts fuel costs and lasts longer. This brick is used in the Haeger Pottery Company kiln exhibit at the Century of Progress.

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BIN-DICATOR is a bin level indicator, manufactured by the Ripley Manufacturing Company, Wayne, Michigan. This device is used to indicate the level of cement in bins or hoppers (for full description see page 30).

◆ Industrial Literature ◆

LINK-BELT News, Vol. 1, No. 1, August, 1934, devoted to the applications of conveying and power transmitting machinery for solving the modern problems of industry has just appeared. It is 8 pages 11½ x 16¼, is well illustrated, contains descriptions of recent installations, advertisements, reviews of new catalogs, last minute news of the organization, and "News-in-Pictures." It is sent gratis to anyone requesting it on a business letterhead.

◆ Manufacturers' News ◆

A GIANT conveyor belt built by the Manhattan Rubber Mfg. Division of Raybestos-Manhattan, Inc., for a limestone plant is nearly a quarter of a mile (1,291 ft.) long and 4 ft. wide— over 5,000 sq. ft. of tough rubber. It is 7 x 9 ply, heavy duck construction with a ¼-in. reinforcement on top and a 1/16-in. reinforcement on back. Sixteen bales of raw cotton were used in making it. It weighs 11 tons and will deliver 1,500 tons (136 times its own weight) of crushed limestone every hour.

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A WEIGHING feeder with capacities ranging from 2 lb. to 1,000 tons an hour is described in Bulletin 33B being distributed by the Hardinge Company, Inc., York, Pa. The conveyor is pivoted and counterbalanced. The belt tilts one way or the other and the feed gate is hinged to open or close as the weight of the material on the belt varies. To change the rate of feed it is only necessary to change the position of the counterweight.

●

SUPEREX insulating blocks, recently announced by Johns-Manville, New York, for temperatures ranging up to 1900 deg. F., are described in engineering folder IN-28-A. The blocks are made of calcined diatomaceous silica, blended and bonded with asbestos fibre.

Among the Manufacturers

AMERICAN Cyanamid & Chemical Corporation announces the acquisition, effective July 1, 1934, of the plant, properties and business of Burton Explosives, Inc., Cleveland, Ohio, engaged in the manufacture and sale of high explosives and blasting supplies since its organization in 1930.

●

A COMPLETE line of non-electric thermostatic valves—self-contained units for automatic and remote control of temperature and pressure—are being manufactured by Fox Engineering Company, Boston, Mass.

●

W. R. Judson has been appointed manager of their Salt Lake City District Office, Kearns Building, Salt Lake City, Utah, by Allis-Chalmers Mfg. Co., Milwaukee, Wis. In Salt Lake Mr. Judson succeeds *H. E. Weiss*, who has been transferred to the company's office at Kansas City.

William R. Ellis has been appointed assistant general manager of Hercules Powder Company's Explosives Department, R. H. Dunham, president, announces.